Library

Inventory and Monitoring of Bald Eagles and Other Raptorial Birds of the Snake River, Idaho

by
Michael B. Whitfield
Mary E. Maj

TECHNICAL BULLETIN NO. 96-12
IDAHO BUREAU OF LAND MANAGEMENT
August 1996

INVENTORY AND MONITORING OF BALD EAGLES AND OTHER RAPTORIAL BIRDS OF THE SNAKE RIVER, IDAHO

1995 PROGRESS REPORT

Michael B. Whitfield, Research Associate, Northern Rockies Conservation Cooperative, Jackson, Wyoming, and P. O. Box 241, Tetonia, Idaho 83452

Mary E. Maj, Wildlife Biologist, P. O. Box 263, Tetonia, Idaho 83452

Executive Summary

The Snake River Raptor Project, a five-year effort, was initiated in 1994, with two primary objectives: 1) to monitor bald eagle productivity in Southeast Idaho, and 2) to develop a monitoring program for raptorial birds in the study area. The Snake River corridor is recognized for its productive bald eagles and diverse array of raptors.

In 1995, nesting bald eagles were monitored at 42 bald eagle breeding areas in Southeast Idaho. Of these 42 known territories, 39 were occupied, 29 were active, and productivity at occupied sites was 1.00 advanced young per occupied nest. Lower elevation nests were generally very productive (3 young at each of 4 nests), whereas those at higher elevations such as Island Park and Palisades Reservoir were notably poor. Three new breeding areas were located in 1995: Hog Hollow (18-IS-23) on the lower Teton River, Five Ways (18-IS-24) within a portion of what was the Pine Creek breeding area (18-IS-07), and Big Bend (18-IC-18) at what was the margin of the Moonshine (18-IC-11) and Last Chance (18-IC-12) breeding areas. We observed 5 nesting adults that were banded as nestlings in the GYE, and determined the natal nest of 3 of these adults. In 1995, 13 Idaho/GYE nestlings were banded to facilitate future population monitoring.

In 1994 and 1995, we recorded presence/absence surveys in 437 randomly selected sample quadrats, with at least one raptor detected in 179 sample quadrats, and no birds seen in 258 sample quadrats. We detected 17 raptor species within our sample areas (at least 3 more species occur in the area, but were not detected). Eight species were seen frequently enough to allow analysis of macro-habitat selectivity, and all of these were significantly selective in their macro-habitat preferences (chi-square goodness of fit, p values $< .001$). Cottonwood, Douglas fir, and sageland habitats were used far more than expected under random association. Tilled cropland was the primary vegetative cover type in more randomly selected samples than any other cover type (129 = 30% of samples, tilled cropland = 35% of total area), but represented only 4% of samples where raptors were detected. Two sagebrush dominated quadrats featured the greatest diversity of detected species, one with four species and another with five.

We are currently witnessing the gradual loss of several historically productive bald eagle nesting areas, nesting areas located on private lands that are now being intensively developed. This is most apparent in the South Fork reach from Palisades Dam to Conant Valley, and highlights the importance of protected habitats under public ownership throughout the Snake River study area. In the past two years of searches for nesting raptors within this area, we have also documented the high value of riparian cottonwood forests and nearby Douglas fir forests for many other nesting birds of prey.

Introduction

This progress report documents the second year of a five-year project to monitor raptorial birds within the Snake River ecosystem of southeastern Idaho. The project goal is to develop monitoring tools that can be applied to conservation at several levels: nesting bald eagle populations, raptorial birds, and biological communities generally (see discussion in Whitfield et al. 1995).

Objectives

I. Determine bald eagle productivity and document habitat observations for bald eagle breeding areas within the Idaho portion of the Greater Yellowstone Ecosystem. Specific 1995 tasks within this objective are:
a. Complete bald eagle nesting area surveys for each breeding area.
b. Monitor and assess the effects of human disturbance to each breeding area as noted during activity and productivity surveys.
c. Provide preliminary identification of key use areas and important habitat use areas for the following bald eagle breeding areas: Swan Valley (18-IS-05), Antelope Creek (18-IS-11), and St. Anthony (18-IS-15). St. Anthony was substituted for Menan Buttes because of the difficulty of access to Menan Buttes in this high water year.

II. An overall goal of this five-year project is to develop an inventory and monitoring program for all raptorial birds of the Snake River study area (Species listed in Table 1). The 1995 objective is to continue Phase 1, presence/absence surveys with randomized sampling, to determine raptor species occurrence and broad-scale habitat relationships (see methods).
a. Develop preliminary presence/absence sampling regimes and select initial samples.
b. Identify broad-scale vegetation types within selected sample areas.
c. Complete presence/absence surveys for raptors within selected sample areas.
d. We have also added to the literature search completed in the 1994 progress report (Whitfield et al. 1995) by providing a synthesis of current raptor habitat management recommendations from the literature.

Study Area

The 119 mile long reach of Snake River corridor identified in the BLM and Forest Service 1991 Snake River Activity/Operations Plan is the core of the study area (figure 1). This area includes the South Fork of the Snake River from Palisades Dam beyond the confluence to Market Lake Canal, and Henry's Fork from St. Anthony to its confluence with the mainstem Snake. The study area is expanded to include upland habitats within 1 mile on each side of river. In preliminary studies, the investigators located breeding raptors which nest within this expanded area and rely in part upon the riparian bottom for foraging habitat.

The upper section of the South Fork below Palisades Dam flows through a mountain valley, Swan Valley, Idaho. It then flows into a rugged, deeply incised canyon approximately 26 miles in length. The lower South Fork and the Henry's Fork below St. Anthony meander

Table 1. Raptor species codes for raptorial birds to be inventoried and monitored in the Snake River study area.

Common Name	Scientific Name	Abbreviation	Number	Occurrence in Study Area[1]
Bald Eagle	Haliaeetus leucocephalus	Ha. le.	1	Known, this study
Golden Eagle	Aquila chrysaetos	Aq. ch.	2	Known, this study
Osprey	Pandion haliaetus	Pa. ha.	3	Known, this study
Northern Goshawk	Accipiter gentilis	Ac. ge.	4	Known, this study
Cooper's Hawk	Accipiter cooperii	Ac. co.	5	Known, this study
Sharp-shinned Hawk	Accipiter striatus	Ac. st.	6	Known, this study
Red-tailed Hawk	Buteo jamaicensis	Bu. ja.	7	Known, this study
Swainson's Hawk	Buteo swainsoni	Bu. sw.	8	Known, this study
Feruginous Hawk	Buteo regalis	Bu. re.	9	Potential
Northern Harrier	Circus cyaneus	Ci. cy.	10	Known, this study
Peregrine Falcon	Falco peregrinus	Fa. pe.	11	Known, this study
Prairie Falcon	Falco mexicanus	Fa. me.	12	Known, this study
Merlin	Falco columbarius	Fa. co.	13	Potential
American Kestrel	Falco sparverius	Fa. sp.	14	Known, this study
Turkey Vulture	Cathartes aura	Ca. au.	15	Known, this study
N. Saw-Whet Owl	Aegolius acadicus	Ae. ac.	16	Known, this study
Northern Pigmy Owl	Glaucidium gnoma	Gl. gn.	17	Known, reports
Western Screech Owl	Otus kennicottii	Ot. as.	18	Known, reports
Flammulated Owl	Otus flammeolus	Ot. fl.	19	Known, this study
Short-eared Owl	Asio flammeus	As. fl.	20	Suspected
Long-eared Owl	Asio otus	As. ot.	21	Known, this study
Great Horned Owl	Bubo virginianus	Bu. vi.	22	Known, this study
Great Gray Owl	Strix nebulosa	St. ne.	23	Potential
Barred Owl	Strix varia	St. va.	24	Potential
Boreal Owl	Aegolius funereus	Ae. fu.	25	Potential
Burrowing Owl	Athene cunicularia	At. cu.	26	Potential

across broad, braided flood plains. Much of the South Fork in these lower reaches is contained by a dike system.

Much of the river is bordered by riparian cottonwood gallery forests recognized as among the largest and most intact in the western United States. Beyond the floodplain, landscapes on each side of the river include a rich diversity of vegetative cover and topographical relief: conifer and aspen covered foothills, park-like pasture lands and cultivated crop lands; precipitous canyon walls; sage, mountain mahogany, and juniper covered slopes; and steep, rocky mountains. The lower reaches feature biologically rich sloughs and wetlands. The South Fork and lower reach of the Henry's Fork are recognized as a primary biological asset of the Greater Yellowstone Ecosystem.

Bald eagles are monitored within a larger region, the Idaho portion of the Greater Yellowstone Ecosystem. This area includes Southeast Idaho west to Interstate 15 from the Montana border to Idaho Falls, and the Snake River watershed south to the Wyoming border

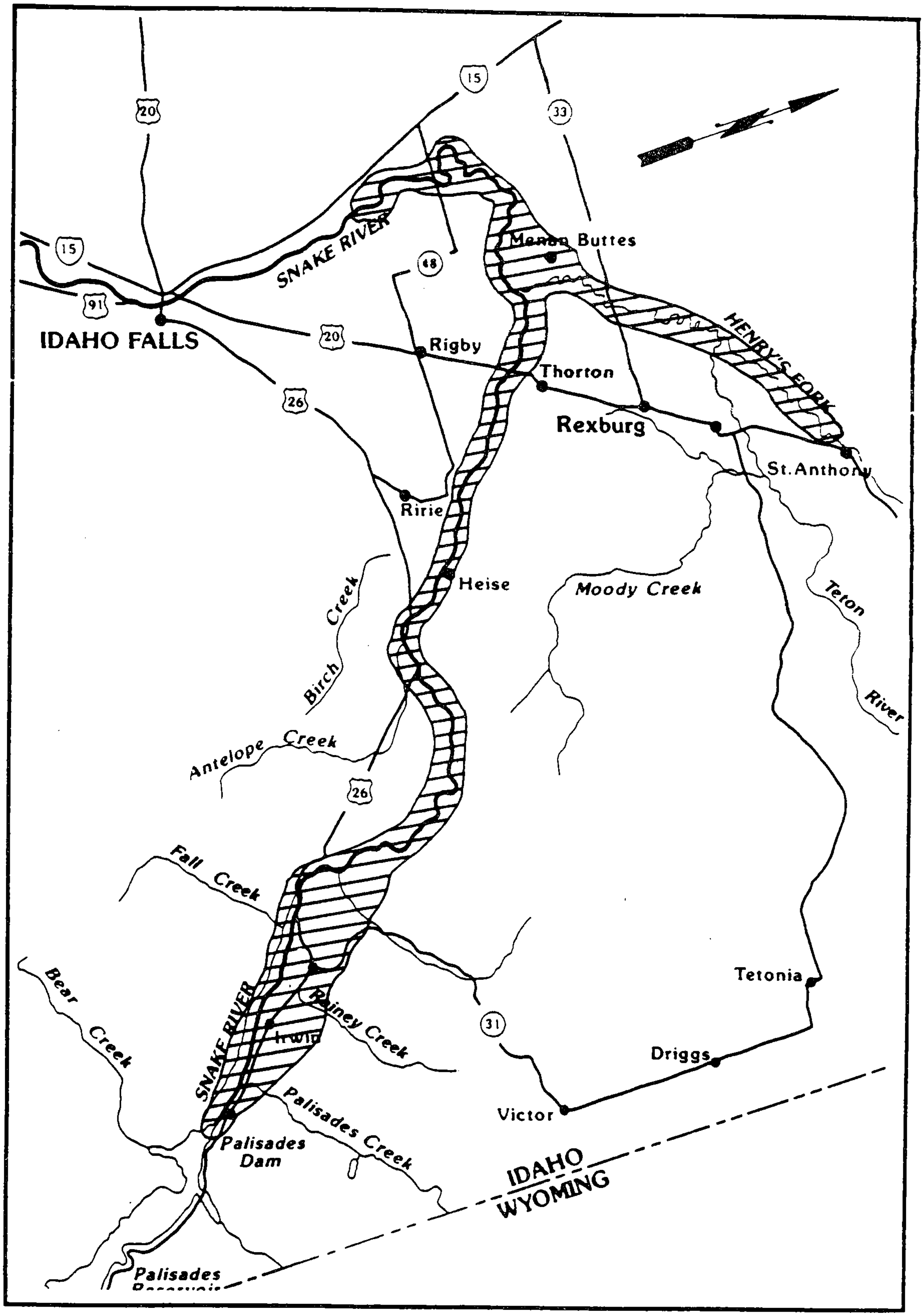


Figure 1. Snake River study area. This map is taken from the Snake River Activity/Operations Plan (USDI BLM and USDA Forest Service 1991). Scale 1 : 500,000

at the upper end of Palisades Reservoir. This larger region includes the Snake River study area plus the upper Henry's Fork in Island Park, outlying lakes like Sheridan Reservoir, and Henry's Fork tributaries such as the Falls and Teton River watersheds.

Methods

Bald Eagle Monitoring

All known and suspected bald eagle breeding areas are surveyed to collect the following data: nest occupancy, breeding activity, breeding success, and number of advanced young produced. All nest sites are visited a minimum of twice: early for an activity (incubation) check and later for a productivity check. In most cases, additional activity checks are necessary to more clearly document activity or to locate new alternate nest sites. Nesting chronology is monitored where reliable data can be obtained.

Activity checks are completed by a combination of aerial and ground or boat surveys. Most early ground checks are from long distance with spotting scopes to avoid disturbance to adults. Later visits are made to measure productivity at active nest sites. Nestlings are banded during this visit where nest trees can be safely climbed. Our experience of 11 years of monitoring bald eagle nesting activity and productivity in this region suggests an area-specific strategy for bald eagle monitoring (see Appendix Table 1, Whitfield et al. 1995).

Definitions used for bald eagle reproductive terminology are as follows:
Breeding area. This refers to the area used by one nesting pair of adult bald eagles and containing one or more nest sites.
Occupied breeding area or nest. A breeding area, or nest within a breeding area, with evidence of bald eagle use during part of the breeding season. Occupancy occurs if a) two adults are seen at or near an empty nest within the breeding season, b) one adult and one subadult are seen at or near a nest during the breeding season and there are displays of reproductive behavior, c) there is clear evidence of recent nest repairs or new nest construction, or d) observations that identify the nest as active as defined below.
Active breeding area or nest. Incubating pair. A breeding area, or nest within a breeding area, with clear evidence of bald eagle reproductive effort during the breeding season. An active nest is one where incubation, eggs, or nestlings are observed. Incubation posture does not necessarily infer incubation, and actual incubation should be assumed only if an adult remains in the posture for several hours or an exchange of incubation duty by adults is observed. (Revised GYE Bald Eagle Working Group guidelines in draft substitute Active with the term "Incubating Pair".)
Successful breeding area or nest. A breeding area, or nest within a breeding area, where advanced young are produced. Advanced young are young of the year at or near fledging age.

Development of Raptor Monitoring Program

Our raptor inventory is iterative over the five years of the project, with an additive progression through phases as the data is collected and analyzed. We include here a summary of the methods to be used over the life of the project to provide perspective for each year's work (also see Whitfield et al. 1995). Sampling methods, including raptor species detection and estimation of relative abundance and breeding productivity, must be species specific.

Once our inventory has provided a reliable baseline, we will develop a long-term monitoring program for the raptors of the South Fork study area. This program will employ a sampling design that will yield statistically reliable species-specific measures of breeding pair density and productivity. Time and cost efficiency will be emphasized to ensure that long-term monitoring is practical. Suggestions for applicability to other areas and other biological groups will be made.

Breeding Raptor Detection.

We apply species-specific raptor detection methods. We provided a literature review of raptor detection methods in Whitfield et al. 1995. We will also analyze delectability models from a statistical perspective as the project progresses.

Raptor Inventory.

Our raptor inventory occurs in two phases as follows:

Phase 1. Presence/Absence Sampling. Sample sites are selected to cover a broad array of biological and physical attributes; such coverage will help assure adequate representation of species composition and distribution over the study area. Sampling must be exhaustive enough to minimize under-sampling effects on patterns while allowing true patterns or gradients across the study area to be identified, described and predicted. With respect to monitoring, sampling must also ensure that study-wide trends and change can be distinguished from localized fluctuations (McKenzie et al. 1991). Hence the number, placement, and size of the sample sites will require careful consideration from both the biological and statistical perspectives.

In 1995, we entered all potential samples, all square mile sections within the study area, into a Latin Square table with samples containing similar habitats grouped within the table. We then randomly selected samples according to a Latin Square plus 1 design. We used mapped legal sections because there are often section markers on the ground that aid in sample location. We selected from all square mile sections that were at least 50% within 1 mile of the river. We then individually sampled all 40-acre quadrats (16 per square mile section) within selected sections.

Data recorded at each sample site consist in part of the following: sample date and geographic location, stratum type, habitat patchiness with estimated relative percentages of patch-type, raptor species present, and the within-site geographical location of individuals, nest sites and the like. Statistical analyses will provide information on species composition and habitat associations. These results will be used to predict geographical distributions of presence for individual species and species assemblages over the study area.

Phase II. Estimating Relative Abundance of Nesting Pairs. Data and results obtained from this survey will be invaluable for the second phase of the project: estimating relative abundance and distribution of key species This phase will commence in the third year of the project, 1996. We will also begin to monitor raptor nest sites to measure nesting activity and productivity parameters in 1996.

Habitat description

For Phase 1 surveys (presence/absence) completed in 1995 and reported here, we characterized each 40 acre sample quadrat by general vegetation cover type according to the system developed by Ulliman et al. (1991), which includes 30 cover types (Table 2). We indicate the dominant cover type found within each quadrat, with recognition that many quadrats feature a complex mosaic of vegetative cover types (Appendix Table 5).

As the project matures, our habitat measures will become more refined to characterize features selected by individual raptor species. We hope to characterize, at a landscape level, habitat features found within areas estimated to include the home ranges of nesting raptor pairs. We will also measure habitat features around all nest sites to determine those features of importance to nest occupancy and success.

Table 2. Snake River study area vegetative cover types after Ulliman et al. (1991).

Level I	Level II	Level III
1 Urban	11 Residential	111 Residential
	12 Commercial	121 Commercial
	13 Industrial	131 Gravel pits, quarry
	14 Transportation	141 Roads, transportation services
2 Agriculture	21 Cropland, Pasture	211 Tilled cropland
		212 Permanent pasture
	24 Other	241 Buildings and associated areas
		242 Irrigation canals
		243 Dikes and dams
3 Rangeland	31 Grassland	311 Upland grasslands
	32 Shrubland	321 Sagebrush-bitterbrush
		322 Mountain mahogany
		323 Upland shrubland
4 Forestland	41 Deciduous	411 Aspen, closed (› 75% cover)
		412 Aspen, open (‹ 75% cover)
	42 Evergreen	421 Douglas-fir
		422 Juniper
5 Water	51 Riverine	511 Upper perennial
		512 Lower perennial
6 Riparian	61 Nonwoody	611 Grasses
		612 Sedges
	62 Woody	621 Willow
		622 Dogwood
		623 Cottonwood
7 Barrenland	74 Exposed Rock	741 Bedrock outcrops
		742 Scree slopes

Results and Discussion

1995 Bald Eagle Nesting Activity and Productivity

There are currently 42 known bald eagle breeding areas within the Southeast Idaho portion of the Greater Yellowstone Ecosystem (GYE). Of this total, 24 are found within the Snake Idaho Unit of the GYE population, and 18 in the Continental Idaho Unit (Whitfield et al. 1995 b). In 1995, 39 of the 42 known territories were occupied, and 29 were active. Known 1995 productivity at these sites was 1.00 advanced young per occupied nest.

This year, 1995, was a reversal of 1994 trends, with many similarities to the cold, wet spring of 1993. Lower elevation nests were generally very productive (3 young at each of 4 nests), whereas those at higher elevations were notably poor. The 10 active pairs of the South Fork Canyon (1 new pair) produced 19 young in 1995 (11 young in both 1993 and 1994), and the remainder of the lower elevation nests in the Snake Unit produced 10 young (7 in 1994). Continental Unit territories (18) produced only 10 young in 1995 (16 in 1994 at 17 territories, 8 in 1993 at 16 territories). The 5 nests found near Palisades Reservoir produced no advanced young in 1995 (7 in 1994, only 1 in 1993, 7 in 1992). Overall, poor productivity in 1993 and 1995 appears to be related to wet, cold weather during critical times for later nesting pairs. In Island Park, several eagle nests were snow-covered far into the nesting season.

In 1995, productivity monitoring was very difficult because it was hard to determine actual outcome for many sites. At most sites, we overcame this difficulty by visiting sites more often that usual. Adults were infrequently seen at several nest sites; ten non-productive sites did not initiate incubation as far as we could determine. (It appeared that adults at these sites were as perplexed by the cold spring as were the observers.) Six of 7 unsuccessful breeding areas appeared to fail early in incubation. Five pairs moved to new alternate nests. It is still possible that we missed detecting new alternate nest sites at a few breeding areas, including King Creek, Lucky Dog, Henry's Lake, and Coffee Pot, despite numerous searches.

Three new breeding areas were located in 1995: Hog Hollow (18-IS-23) on the lower Teton River, Five Ways (18-IS-24) within a portion of what was the Pine Creek breeding area (18-IS-07), and Big Bend (18-IC-18) at what was the margin of the Moonshine (18-IC-11) and Last Chance (18-IC-12) breeding areas. Hog Hollow, 18-IS-23, was discovered during an Idaho Department of Fish and Game flight over the lower Teton River. A site in this area has been suspected for several years, and has probably been active in past years. Five Ways, 18-IS-24, on the South Fork above Pine Creek, was built last season by a notably young female (dark feathers on head), with first production this year. The Big Bend adult female appears to be relatively young; her color band indicates that she was banded in 1987 or 1988 in the Snake Idaho Unit. The Big Bend nest was first built in late summer, 1994, in a year when the nearby Moonshine nest produced one fledgling.

This year we observed 5 nesting adults that were banded as nestlings in the GYE, and determined the natal nest of 3 of these adults. Band checks revealed nine adults that were definitely not banded. In 1995, 13 Idaho/GYE nestlings were banded with numbered FWS leg bands on the right leg and color bands with two digit alphanumeric codes on the left leg.

Table 3. Activity and productivity status for bald eagle breeding territories within the Idaho portion of the Greater Yellowstone Ecosystem, 1995.

TERRITORY NAME	TERRITORY NUMBER	PRODUCTIVITY STATUS	NUMBER ADVANCED YOUNG	NUMBER YOUNG BANDED	COMMENTS
PALISADES RESERVOIR AREA					
Hoffman	18-IS-01	Occupied, Inactive	0	0	
Williams Creek	18-IS-02	Active, Unsuccessful	0	0	
Van Point	18-IS-03	Active, Unsuccessful	0	0	
Edwards Creek	18-IS-17	Occupied, Inactive	0	0	
King Creek	18-IS-18	Unoccupied	0	0	
SOUTH FORK SNAKE RIVER					
Palisades Creek	18-IS-04	Active, Successful	2	2	
Swan Valley	18-IS-05	Active, Successful	3	0	
Conant Valley	18-IS-06	Active, Successful	3	3	
Pine Creek	18-IS-07	Active, Unsuccessful	0	0	New alternate nest
Dry Canyon	18-IS-08	Active, Successful	2	0	
Gormer Canyon	18-IS-09	Active, Successful	2	2	
Wolverine	18-IS-10	Active, Successful	1	1	
Antelope Creek	18-IS-11	Active, Successful	2	0	New alternate nest
Cress Creek	18-IS-12	Active, Successful	3	0	New alternate nest
Five Ways	18-IS-24	Active, Successful	1	0	New territory
MAIN SNAKE RIVER					
Confluence	18-IS-13	Active, Unsuccessful	0	0	
Market Lake	18-IS-22	Active, Successful	1	0	
LOWER SOUTH FORK, HENRY'S FORK, FALL RIVER					
Menan Buttes	18-IS-20	Active, Successful	2	0	
Cartier Slough	18-IS-14	Active, Unsuccessful	0	0	
St. Anthony	18-IS-15	Active, Successful	1	0	
Singleton	18-IS-16	Active, Successful	2	0	
Lower Fall River	18-IS-19	Occupied, Inactive	0	0	

Table 3. Activity and productivity status for bald eagle breeding territories within the Idaho portion of the Greater Yellowstone Ecosystem, 1995 (cont.).

TERRITORY NAME	TERRITORY NUMBER	PRODUCTIVITY STATUS	NUMBER ADVANCED YOUNG	NUMBER YOUNG BANDED	COMMENTS
TETON RIVER, SNAKE UNIT					
Upper Teton	18-IS-21	Active, Successful	1	0	New alternate nest
Hog Hollow	18-IS-23	Active, Successful	3	0	New territory
CONTINENTAL UNIT, UPPER HENRY'S FORK SNAKE RIVER					
Kerr Canyon	18-IC-01	Active, Successful	2	2	
Pine Haven	18-IC-02	Occupied, Inactive	0	0	
Box Canyon	18-IC-03	Active, Unsuccessful	0	0	
Coffee Pot	18-IC-04	Occupied, Inactive	0	0	
Bishop Lake	18-IC-05	Occupied, Inactive	0	0	
Sheridan	18-IC-06	Occupied, Inactive	0	0	
Lucky Dog	18-IC-07	Occupied, Inactive	0	0	
Henry's Lake	18-IC-08	Unoccupied	0	0	
St. Spgs-Tar. Cr.	18-IC-09	Active, Successful	1	0	New alternate nest
Hale Canyon	18-IC-10	Active, Successful	1	1	
Moonshine	18-IC-11	Unoccupied	0	0	
Last Chance	18-IC-12	Active, Successful	2	0	
IP Bills	18-IC-13	Occupied, Inactive	0	0	
Flat Rock	18-IC-14	Active, Successful	2	0	
Riverside	18-IC-15	Active, Successful	1	1	
Snake River Butte	18-IC-16	Active, Successful	1	1	
Buffalo River	18-IC-17	Occupied, Inactive	0	0	
Big Bend	18-IC-18	Active, Unsuccessful	0	0	New territory. Blowdown killed 2 advanced young.

Summary Statistics:

Total number nesting territories: 42
Number occupied territories: 39
Number active territories: 29
Number successful territories: 22
Number advanced young: 39

Advanced young/occupied nest: 1.00

Advanced young/active nest: 1.34

Advanced young/successful nest: 1.77

Historic Bald Eagle Productivity: Habitat and Environmental Effects

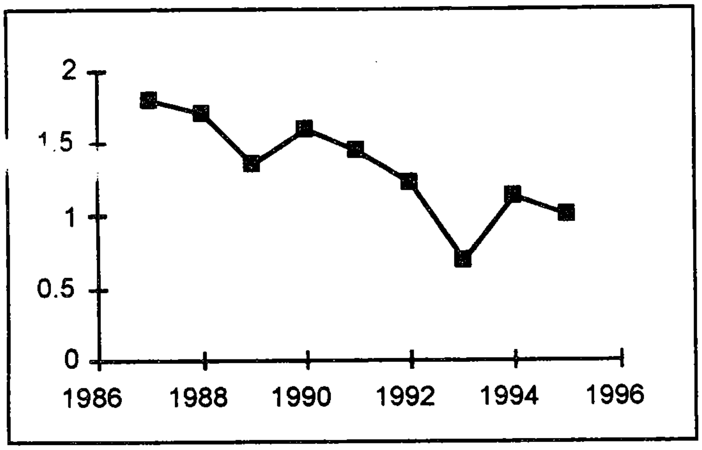
We are attempting a general evaluation of bald eagle productivity in Southeast Idaho over the past decade as a baseline for comments on future habitat management concerns. Although it can be fairly stated that the many factors which influence bald eagle productivity make this analysis difficult (e.g. Fraser et al. 1985), it is timely to summarize current knowledge in order to isolate and manage those factors that can be controlled. Parameters which might govern bald eagle productivity and which are beyond our control, at least in the short-term, include food availability in critical periods, annual precipitation, weather severity and related factors, availability of suitable nest sites, and individual factors such as pair experience and levels of intraspecific agonism. We are attempting the difficult task of analyzing such parameters to clarify our analysis of factors that managers can control, such as levels of human activity in key areas. Our complete analysis of Southeast Idaho productivity will appear in the 1996 productivity report. We begin here with a general look at productivity trends over the period.

Since 1987, productivity monitoring in this region has been intensive enough to suggest that almost all nesting areas were accounted for each year. Table and figure provide a sense of productivity trends over this period. The number of nesting areas and total number of young produced has increased dramatically, whereas the per pair productivity rate appears to have declined. The Greater Yellowstone nesting population has experienced exponential growth over the past two decades, with some indication that the population is approaching habitat saturation (Swenson et al. 1986, Harmata and Oakleaf 1992).

Table 4. Bald eagle productivity at nesting areas in East Idaho, the Idaho portion of the Greater Yellowstone Ecosystem, 1987-1995.

Year	Advanced young/occupied nest (productivity known)
1987	1.80 (n = 20)
1988	1.70 (n = 23)
1989	1.35 (n = 26)
1990	1.59 (n = 27)
1991	1.45 (n = 31)
1992	1.23 (n = 35)
1993	0.69 (n = 35)
1994	1.13 (n = 38)
1995	1.00 (n = 39)

Figure 2. Trend in bald eagle productivity at nesting areas in East Idaho, the Idaho portion of the Greater Yellowstone Ecosystem, 1987-1995.



Below we discuss habitat and environmental parameters as a frame for our ongoing analysis of bald eagle productivity. We discuss generally effects on prey availability, weather, individual pair behavior, and human activity.

Prey availability. Bald eagles in stable populations are thought to be food limited (Sherrod et al. 1977, Stalmaster and Gessaman 1982). Factors which reduce prey availability during critical periods of the nesting cycle can cause reduced productivity. Major environmental factors which influence prey availability include annual precipitation and weather severity. In part because river systems in this area are controlled by storage dams, annual precipitation, most importantly winter snowfall, determines stream flow, water level and fluctuation frequency in reservoirs. Winter weather severity determines the degree of river icing (which is strongly influenced by stream flow), and thus, fish availability at critical periods. Weather severity also influences the availability of other potential prey such as waterfowl, small mammals, and ungulate carrion.

Most raptor breeding failures occur early in the cycle, as females either do not lay eggs, abandon their eggs, or young die soon after incubation (Newton 1979). Brown (1976) recognized two critical periods during the nesting cycle, the pre-laying/egg laying period and the early nesting period immediately after hatching. In the first of these two periods, breeding females need extra food to lay down reserves of body fat and protein for egg laying and subsequent incubation and brooding; females which do not accumulate reserves do not lay (Newton 1979). Although bald eagle egg weights are a small percentage of adult weight (average of 3% of adult female weight, Stalmaster 1987), females face the rigors of approximately 32-35 days of incubation, followed by intensive brooding of young nestlings for approximately 3 weeks. Female condition at time of egg laying is thus a factor in productivity when food sources are particularly critical.

The second stressful period comes immediately after hatching when the young eaglets grow rapidly in size and food requirements and the brooding female still requires food from the male. If prey availability is limited in this period, the male may simply not be able to provide sufficient food. Adult attentiveness at the nest could thus decline at a critical period when adults are food stressed, and nestling fratricide (Stalmaster 1987) may occur.

Weather during the nesting period affects both bald eagle energy needs and prey availability. Newton (1979) cited examples of decreased productivity and delayed egg laying during cold, wet springs in several raptorial species. In tests with captive bald eagles, Stalmaster (1983) found that bald eagle daily energy consumption increases at approximately 4.8 kcal. for each degree C decrease in temperature below ambient air temperatures of 10.6 degrees C. Thus extreme cold and/or windy weather during pre-laying could reduce female body condition, and influence the energy needs of brooding females and young immediately post-hatching.

From 1988 to 1992, we closely monitored 6 nesting areas to determine the level of young nestling mortality. In these 30 observed nesting attempts (6 areas over 5 years), two nest blowdowns resulted in losses of entire clutches within two weeks of hatching, and two clutches at Dry Canyon never hatched despite over 60 days of incubation. In the remaining 26 observations, partial clutch mortality, the death of 1 of 2 hatchlings produced, occurred on at least 3 occasions (11.5% of observations). One brood of two nestlings died of unknown cause on the nest when about 2 weeks old. Three incidental observations of partial clutch mortalities were noted at other sites. Nestlings beyond about three weeks of age rarely died. All advanced nestling mortalities in our observations over 16 years were due to nest blowdowns.

During the cold and wet springs of 1993 and 1995, most of the pairs which nested in higher elevations of this study area did not successfully raise young, even though nesting areas were occupied. In approximately 27 unsuccessful nesting attempts at higher elevations on Palisades Reservoir and in Island Park over these two years, only one failed attempt produced young that survived to advanced age. These 8-week old nestlings were killed in a nest blowdown. In all the other unsuccessful attempts, the pairs either failed to produce eggs, did not hatch eggs, or nestlings died soon after hatching.

Direct weather effects. Prolonged or intensive wet, cold periods or extreme heat during critical periods can also cause direct mortality of young nestlings. The age at which bald eagle young can thermoregulate is at about 3 weeks, if the weather is not too severe (Stalmaster 1987). Locally, critical periods for nesting pairs vary by elevation. At lower elevation sites, bald eagle pairs initiate nesting activity in February, and begin to incubate in early to mid-March. Thus, the young eagles at lower elevation sites are particularly vulnerable to severe weather in April. At higher elevations around Palisades Reservoir and in Island Park, the nesting chronology is up to one month later than at the earliest sites on the South Fork. May is thus a critical period for young nestlings at these higher elevations.

Harmata and Oakleaf (1992) developed a weather severity index for bald eagle nesting after a similar index developed for elk in Montana (Picton 1971). This index relies primarily on mean daily temperature and depth of snow cover on the ground, and does have predictive value for the larger differences in local climate as were detected between geographic areas in lower and higher elevations.

We are attempting to detect the effects of weather differences among years at individual nest sites. We are examining the use of daily minimum air temperature in our calculations of weather severity because during the winter and early spring months under consideration, bald eagles spend upwards of 60% of the 24-hour day under low light conditions when temperatures are usually at their lowest. This temperature also seems a more realistic perspective of temperature extremes than an average, which might mask extreme night-time temperature drops. We are also examining daily precipitation with the assumption that individual precipitation events at nest sites may affect productivity. Broad annual weather effects, such as cold, wet springs, may affect many nesting areas. Individual weather events also occur, such as the windthrows of nests at Pine Creek in 1987, Gormer Canyon in 1988, Antelope Creek in 1992, Cress Creek in 1993, and Big Bend in 1995. Localized micro-bursts can destroy even well-built nests in stable nest trees, although wind is more often a factor when the supporting structure is suspect.

Experience of the nesting pair. In their first year of active nesting, many inexperienced bald eagle pairs fail to raise young. In our records, 7 of 17 certain first attempts between 1983 and 1995 resulted in no young produced. Poor nest construction or nest site selection and inattentiveness were thought to be causes. (Ten other newly discovered nests in this period were not included in the analysis because there was good evidence that these nests had been established at least one year prior to their discovery.) Usually nests that failed were abandoned early in the nesting season, whereas in 1 case, Big Bend, a fragile nest structure blew down and killed advanced young near fledging age. Mean productivity for the 17 new pair attempts was .882 young/nesting attempt (s.d. = .857). Mean productivity in 279 attempts by experienced pairs in comparable years (eliminated two extreme weather years) was 1.301 young/nesting attempt (s.d. = .923), intuitively a rather large difference, but statistically insignificant because of high variability in individual nesting success.

Territorial interactions. As numbers of nesting bald eagle pairs increase, it may be expected that competition for resources will also increase and average productivity decline. Increased territorial aggression would also contribute to a productivity decline. An example of this effect to date may be the Pine Creek bald eagle pair. This pair still occupies its traditional nesting area, but in the two seasons since arrival of the Five Ways nesting pair within what was documented by radio telemetry as a favored foraging area for the Pine Creek pair in prior years, the Pine Creek pair has not been productive. Previously, the Pine Creek pair produced young in every year since establishment in 1977, except 1982 (adjacent Dry Canyon territory established) and 1987 (nest blowdown).

Human activity effects. Humans have had dramatic effects upon bald eagle populations generally across their historic range (Lincer et al. 1979) and specifically within the Greater Yellowstone area (Swenson et al. 1986). Shooting, trapping, and predator control activities contributed to the decline of bald eagles at and beyond settlement, and DDT use led to dramatic declines in the mid-part of the century (Broley 1958, Lincer et al. 1979).

Shooting and other direct human-induced mortality still remove bald eagles, and environmental pollutants may impose limitations that are as yet undetermined (Harmata and Oakleaf 1992). However today, human activities of an indirect affect may present even greater and longer-term threats. Activities which result in permanent loss of bald eagle habitat, such as second home development, are increasingly evident within the Greater Yellowstone area, and activities such as dispersed recreation, which result in temporary disruption of eagle activities, have increased dramatically in recent years (Whitfield 1993).

Early management efforts were focused around protection of nest sites. Grubb (1980) found that nests closer to human activity were less productive than nests farther from human activity. However, Fraser et al. (1985) suggested that association of reduced productivity with human activity is difficult because of the multitude of factors which influence productivity. Fraser et al. (1985) did find that nests built on developed shorelines were farther from water than nests build on undeveloped shoreline. More recent studies examined the influence of human activity on use of foraging areas (e.g. McCarigal et al. 1991). Research in Greater Yellowstone has noted that adults focus their foraging activity early and late in the day, and thus avoid human activities that occur more in middle of day (Harmata and Oakleaf 1992, Whitfield 1993) is this avoidance of humans by eagles or merely response to needs early in day. In our observations in late winter-early spring, eagle foraging activity occurs throughout the day. Thus there is an apparent shift in temporal activity after fishing season opens. However, a further complication is the influence of daytime temperature differences between these seasons. Observed bald eagles do appear to avoid activity in hot periods.

In our analysis, after isolating the influences of parameters such as weather, we will attempt to compare productivity among areas classified by broad categories of human activity, to include:

(1) New industrial or residential development within nesting areas.

(2) Loud humans on the ground within nesting area in critical periods in activities such as dispersed recreation that are unpredictable.

(3) Loud humans on the ground within the nesting area in critical periods, but in activities that are predictable, such as farming of established fields or strongly focused recreation with limited accessibility to critical areas.

(4) Low levels of use of nesting areas, but high levels of human activity in primary foraging areas.

(5) Human activity level low within nesting areas and principal foraging areas.

Problem Areas

One motivation for detailed analysis of productivity effects is the observed decline in productivity at key nesting areas, problem areas. Several bald eagle breeding areas with long, productive histories have not been detectably productive in recent years. Our assessment of the situation in these areas is that these pairs are no longer producing young because of greatly increased summer home development and recreational activity. Other breeding areas, though still productive in 1995, have been extensively altered by human development in recent years, with the prospect that breeding pairs will be forced to relocate to new primary nesting sites within their home ranges, if available, or fail to produce young.

Henry's Lake is the oldest known bald eagle breeding area in Eastern Idaho, with eagles first documented at this site in the 1930s. Between 1976 and 1992, 29 young bald eagles were fledged from nests in this breeding area. However, in 1993-95, we have not observed nesting attempts in the known nesting area. Two adults occupied the known primary nesting area in 1993 and 1994, but none were seen in 1995. Growth in a summer home subdivision near the known nests, and a great increase in year-round human use of the primary nest area, may be the cause of this formerly productive site being unproductive in the last three years. During early spring surveys in recent years, we have noted evidence of a high volume of snowmachine and four-wheeler traffic in the nest stand. In 1994 and 1995, the bald eagle study team searched other Douglas fir stands throughout the home range for potential new alternate nests, but none were located. This pair appears to have abandoned the traditional nesting area. The best scenario is that they are nesting in an area that we have not discovered, but it appears more likely that the Henry's Lake pair has failed to nest in recent years.

The **Pine Haven** breeding area, on the Henry's Fork, has not produced any detected young since 1991. In prior years, Pine Haven was notably productive, with three young produced in two breeding seasons since productivity was first noted in 1983. In 1992-95, adults have been seen in the vicinity of the two known nests on the east side of the river, but no active nesting has been detected. A new river-side lodge, increased summer home development in this stretch of the river, and the popularity of recreational activities on the river bank opposite the nests likely contribute to the pair's abandonment of the known nest sites. The bald eagle team and Targhee National Forest volunteers have searched for new nest areas without success. We have not detected young of the year at traditional foraging areas in later summer when we might suspect that fledged young would be in these areas.

The **Box Canyon** and **I. P. Bill's** nesting areas are likely to be affected by development of a new subdivision on the shoreline of Island Park Reservoir in the near future. Developers are eager to upgrade road access into this area and begin development of over 80 subdivision lots. The area to be developed includes the favored foraging areas used by the Box Canyon pair. The I. P. Bill's pair forages primarily in areas farther to the west, but the nest site is within approximately 500 meters of the development, and will likely be affected by increased human activity in the area.

A nest was first built within the **Swan Valley** breeding area in 1967, the oldest reestablished breeding area on the South Fork. In 4 of 5 years from 1989 to 1993, no young were produced at the historic nest. This pair moved downriver to a less disturbed area in 1994, and has produced young in the last two years. However, now a new subdivision has been platted in the vicinity of this new nest site. The Fox Creek Ranch Subdivision, mostly in the NW and SW 1/4s of Section 2, newly approved in 1996, allows 14 lots. In section 12, near the nest used in all but one year from 1978-1993, the South Fork Ranch subdivision allows 14 lots, with more planned for the future. In the SW 1/4 of Section 7, Swan Valley Ponds Estates features 4 small lots, and the remainder of the 1/4 section has 5 different owners. In Section 18, where the Swan Valley pair nested in 8 of 9 years after 1968, 34 lots are platted in 3 subdivisions. Another 12 lots are platted on the southwest side of the river in SW 1/4 (6 lots, Snake River Subdivision) and SE 1/4 (6 lots, Flat Iron Ranch) in this section. Also on the southwest side of the river in Section 10, near favored perches used by the Swan Valley pair in 1995, 14 lots have been platted in the Falls Ranches Subdivision. Development of these subdivisions is underway, and it now appears that the Swan Valley pair will be forced to nest on the west side of the river if they are to produce young.

The vicinity of the **Palisades Creek** nest was entirely platted for subdivision in late 1995 and early 1996. The nest is located in the NE 1/4 of Section 34. In the SW 1/4 of Section 27, there are 5 platted lots in the Triple J Dairy Partnership Subdivision. A new (1996) subdivision in the SW 1/4 of the SE 1/4 near the eagle nest, the Eagle View Subdivision, has 14 platted lots. This subdivision extends under the eagle nest in Section 34, and on into Section 35. The remainder of Section 35 is entirely subdivided, with 14 lots on the northeast side of the river.

Section 28 further downriver is also entirely subdivided, with 10 lots in Fleming East Subdivision on the northeast side of the river, and 10 lots in Lott Ranch Subdivision on the southwest side of the river. Human use of the nest area increased dramatically in late 1995 and early 1996 as surveyors and planners prepared subdivision plots. Future construction within these subdivisions will at best force the pair to nest away from the activity, and may eliminate this productive nesting area entirely.

A new subdivision was recently approved for most of the west side of the river in the immediate vicinity of the **Conant Valley** nest used in most years since the late 1970s (29 young produced since 1982). This Conant Valley subdivision allows 103 lots on 350 acres. As at the Palisades Creek breeding area, the vicinity of the nest used since 1988 was frequently visited by surveyors and others during the fall and winter of 1995. This pair has occasionally nested on the large island on the opposite side of the main channel, but most of the favored foraging area is within the area proposed for development.

Bald Eagle Breeding Areas, Preliminary Key Use Identification

We provide baseline information on three bald eagle breeding areas for use in development of breeding area management planning. We have not completed intensive observations within these breeding areas, and do not know the complete extent of foraging area and home range use. We do provide a summary of breeding area history and productivity, nesting chronology, occupied nest zones, and comments on known foraging and perching areas and breeding area habitat quality. Our maps provide a preliminary view of the key use area for each breeding area discussed.

<u>Swan Valley 18-IS-05</u>

Breeding Area History. A bald eagle pair built a nest in the Swan Valley breeding area in 1967, the first breeding area to be re-established on the South Fork Snake River. From 1968 to 1975, this breeding area produced an impressive average of 2.1 advanced young/year (Table 5). In more recent years, productivity in this breeding area has been inconsistent, with many nesting failures (e.g. no young produced 1991-1993).

There have been several adult mortalities in this area over the years. Remains of an adult bald eagle were found downstream of the nest during the nesting season in 1980. The cause of mortality was not determined. On 6/3/93, an adult bald eagle from the Swan Valley territory that had been grounded by an apparent collision injury to a wing was turned in to the Idaho Department of Fish and Game. This bird's wings were so severely damaged by a suspected long period on the ground that it was not possible to rehabilitate it for life in the wild. Reportedly, the second adult had been feeding the injured adult on the ground.

As of 1995, 5 of 6 different nests used within the Swan Valley breeding area were in cottonwoods on the northeast side of the river. Information on actual nest locations is somewhat confusing, but the following is our interpretation of Swan Valley nesting records. Nest #1, built in 1967 and used for 8 of the next 9 years, was located in the NW 1/4 Sec 18, R44E, T1N. This nest apparently blew down after the 1975 nesting season. Nests #2 (in NW 1/4 of Sec. 12, R43E, T1N) and #3 (SW 1/4 Sec. 2, R43E, T1N) were used only 1 and 2 years respectively. Nest #4 was occupied in 15 years from 1978-1993 in a prominent cottonwood in the NW 1/4 of Sec 12, R43E, T1N. Although currently intact and in apparently good condition, this nest sometimes became unstable during the nesting season. For example, the bottom fell out in 1979, with resultant mortality of one nestling. Banders noted this nest's instability during banding entry several times in the 1980s. Nest #4 has been used by Canada geese in several recent years after bald eagle nesting failures or when the eagles were active at another site. Nest #5, an old great blue heron nest in a Douglas fir on the west side of the river in the SE 1/4 Sec.12, R43E, T1N, was used successfully by bald eagles in 1984. Bald eagle use of nest #6, in an old-growth cottonwood in the NE 1/4 Sec.11, R43E, T1N, was first noted in 1994. Nest debris found at the base of the nest tree suggested that this nest was built earlier. The nesting pair successfully fledged young from nest #6 in 1994 and 1995, but the nest tree is likely to fall apart in the next few years due to rot in the trunk and primary limbs.

Table 5. Known productivity at the Swan Valley bald eagle breeding area since re-establishment of nesting pairs on the South Fork Snake River.[1]

YEAR	NESTING STATUS	NUMBER YOUNG FLEDGED	NEST NUMBER	COMMENT
1967	Active, unknown	?	Nest #1	Nest built.
1968	Active, Successful	2	Nest #1	
1969	Active, Successful	2	Nest #1	
1970	Active, Successful	2	Nest #1	
1971	Active, Successful	2	Nest #1	
1972	Active, Successful	2	Nest #2	
1973	Active, Successful	2	Nest #1	
1974	Active, Successful	2	Nest #1	
1975	Active, Successful	3	Nest #1	
1976	Active, unknown	?	Nest #3	
1977	Active, unknown	?	Nest #3	
1978	Active, unknown	?	Nest #4	
1979	Active, Unsuccessful	0	Nest #4	Bottom of nest fell out.
1980	Active, Unsuccessful	0	Nest #4	
1981	Active, Successful		Nest #4	
1982	Active, Successful	2	Nest #4	Banded
1983	Active, Successful	2	Nest #4	Banded
1984	Active, Successful	1	Nest #5	
1985	Unoccupied	0	Nest #4	
1986	Active, Successful	1	Nest #4	
1987	Active, Successful	2	Nest #4	Banded
1988	Active, Successful	1	Nest #4	Banded
1989	Active, Unsuccessful	0	Nest #4	Young eaglets died.
1990	Active, Successful	1+	Nest #4	Number young unknown.
1991	Active, Unsuccessful	0	Nest #4	
1992	Active, Unsuccessful	0	Nest #4	Failed late in incubation.
1993	Active, Unsuccessful	0	Nest #4	Failed early
1994	Active, Successful	1	Nest #6	Poss. used in prior years.
1995	Active, Successful	3	Nest #6	

[1] Productivity data from records compiled by BLM and Idaho Dept. of Fish and Game for 1967-1983. Productivity data from 1983-present from agency reports and reports compiled by M. Whitfield et. al.

Nestlings were banded in the Swan Valley breeding area in 1982 (2), 1983 (2), 1987 (2), and 1988 (1). One of the youngsters banded in 1982 was subsequently recovered dead northeast of Menan, Idaho in March, 1986. Another eaglet banded in 1987 was found dead on the dike between Lorenzo and Menan in March, 1992.

M. Whitfield, under contract with Targhee National Forest, built an alternate nesting platform in a large Douglas fir in the SW 1/4 Sec.12, R43E, T1N, on the west side of the river in 1991. Bald eagles have not been detected at this potential nest site in subsequent years, but the site is a possible alternative if nesting becomes untenable on the east side of the river.

Nesting Chronology. It appears that incubation is initiated in this breeding area up to two weeks later than at adjacent breeding areas on the South Fork. In 1992, an adult was still in incubation posture on April 16 (later failed). Typically, incubation begins in the Swan Valley breeding area around March 10, with a range of estimated initiation dates of March 5 to March 17. Hatching occurs around April 15, with fledging expected in mid-July.

Occupied Nesting Zone, Zone 1. Zone 1 is defined as the area around nest sites within which the presence of humans first causes significant stress to nesting adults. This area has been found to generally be the area within 400 m or 1/4 mile of an occupied nest. Sight specific monitoring suggests that the zone 1 radius may be greater in areas upslope from nests, and lesser in areas downslope of the nest or separated from the nest by a river or similar barrier. In the Swan Valley breeding area, this zone now applies to the 3 alternate nests that are still intact, numbers 4, 5, and 6, which have been used since 1984 (figure 3).

Key Use Areas, Known Foraging and Perching Areas. In years prior to 1995, adult perches were noted during incidental observations. In summer 1995, observers spent approximately 20 hours monitoring adult and fledged juvenile movements in this breeding area. The key use areas noted in these observations are noted in figure. The adults perched on both sides of the river in the nest vicinity, and made foraging attempts in the river at this point. The adults took fish from the area upriver of Fall Creek Falls, and perched prior to foraging in a snag cottonwood in this area. Adults and fledged young frequently used perches in a bushy Douglas fir and nearby trees on the ridge crest southwest of the SW of the junction of the River Road and Fall Creek Road. The key use area shown in figure includes portions of the breeding area which are increasingly unavailable due to housing development, but which may be used in time periods when human activity is minimal.

Breeding Area Habitat Quality. Habitat quality within the Swan Valley Breeding Area may be dramatically altered within the next few years because of recreational home development. Habitat alteration for homesite development along the river corridor has already greatly reduced the available nesting area on the northeast side of the river.

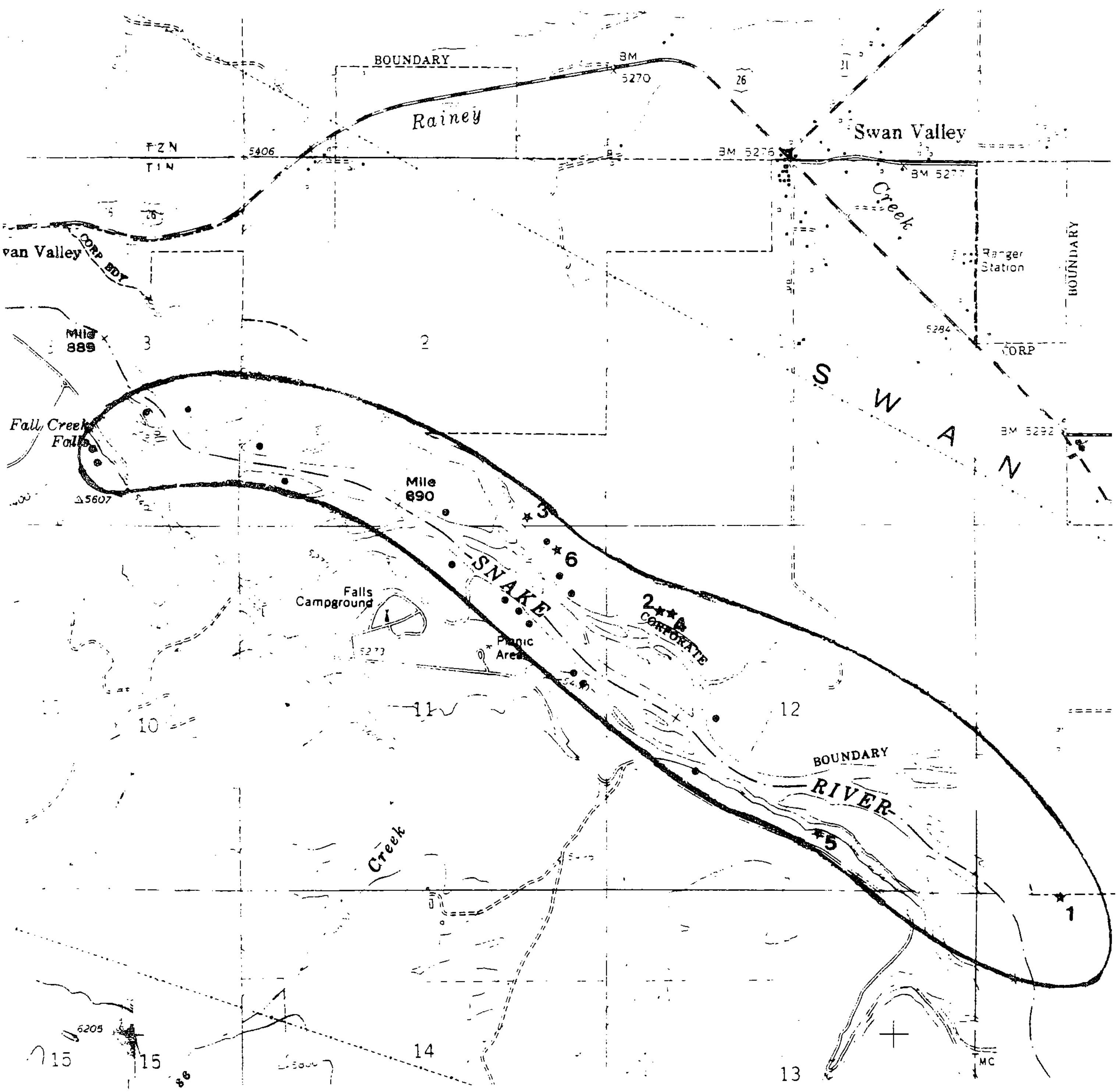


Figure 3. Known key use area within the Swan Valley bald eagle breeding area, South Fork Snake River. Intensive monitoring has not occurred at this breeding area, and the information portrayed is preliminary only. The red line encloses the Principal Management Area. Numbers indicate known nest sites, numbered chronologically.

Antelope Creek 18-IS-11

Breeding Area History. Bald eagle nesting activity in this territory was first noted on Wolf Flat in spring, 1984. An apparently young, inexperienced pair built and incubated on a nest in a cottonwood on Wolf Flat near the South Fork road. The nest was built when there was still snow on the road, and little human activity, but was soon abandoned when the road opened and recreational use of the area increased. The pair continued to incubate until April 24 but the nest was soon abandoned when the road opened and recreational use of the area increased. Between May 2 and May 10 the nest had blown down and adult bald eagles were no longer observed in the area on a consistent basis.

In 1985, the pair probably nested in a Douglas fir across the river, a nest later identified as number two for the territory. This nest was not discovered until 1986. A recently fledged juvenile was seen with the adults in 1985.

In 1986 a new nest, alternate number two, was found across the Snake River from the 1984 nest in a live Douglas fir at mid-slope. The Antelope pair successfully fledged two young each year from nest number two in 1986 and 1987 and evidence at the nest tree suggested that it may have been used by nesting bald eagles in 1985. In 1987, both young were banded and one fitted with a backpack radio tag. The tagged juvenile gradually moved upriver, and was last seen on the South Fork below Burns Creek on September 2. It was subsequently found wintering in the Klamath Basin on the Oregon/California border in 1987 and 1988, and in 1991 nested near Hauser Lake, Montana (Harmata and Oakleaf 1992).

The Antelope pair continued to use nest number two in 1988 and 1989. In 1988, a nestling estimated at 2.5 weeks old was found dead on the nest. Two young eaglets were produced in 1989, although only one successfully fledged.

A new nest (number 3) was discovered upriver of the 1989 nest on March 25, 1990, and two advanced young were produced. In 1991, nest number three was again used. A newly hatched eaglet and one unhatched egg were observed at this nest on April 12, 1991, but only one eaglet survived to fledging. This bird was last seen successfully flying in the nest area on July 31. On March 6, 1992 observations from the west rim of the canyon revealed an incubating adult and 2 eggs in nest number three. However, a local microburst and high wind storm blew the nest out of the tree in early April. During a later visit to the site, S. Austin found two skulls (skunk and raccoon) and broken egg shells in the nest remains.

Adult bald eagles were occasionally observed in the territory in 1993 though a nest was never located that year. Evidence of successful nesting was observed however, on July 13, 1993 when 2 adult bald eagles accompanied and defended 2 fledged young within the territory. In 1994, a new nest was constructed in a snag down slope of nest number three. An adult was observed feeding a single nestling on April 24. Another new nest in a live Douglas fir (nest number five) was located in 1995 along the west end of the territory on the south side of the river. Two youngsters were produced and eventually fledged in July. By the end of July both juveniles were making forays throughout the nesting area and eventually left the territory by mid-September.

Table 6 Known productivity at the Antelope Creek bald eagle breeding area since re-establishment of nesting pairs on the South Fork Snake River.[1]

YEAR	NESTING STATUS	NUMBER YOUNG FLEDGED	NEST NUMBER	COMMENT
1984	Active, Unsuccessful	0	Nest #1	New nest, failed early.
1985	Active, Successful	1	Nest #2	Young of year with adult.
1986	Active, Successful	2	Nest #2	Not banded.
1987	Active, Successful	2	Nest #2	Banded, 1 radio-tagged.
1988	Active, Unsuccessful	0	Nest #2	1 nestling died at 2.5 weeks.
1989	Active, Successful	1	Nest #2	1 downy nestling died.
1990	Active, Successful	2	Nest #3	New alternate nest.
1991	Active, Successful	1	Nest #3	1 egg or young died, 1 fledged.
1992	Active, Unsuccessful	0	Nest #3	Nest blowdown near hatching.
1993	Active, Successful	2	Nest #4	Nested on old osprey nest.
1994	Active, Successful	1	Nest #4	
1995	Active, Successful	2	Nest #5	New alternate nest.

Productivity data from agency reports and reports compiled by M. Whitfield et. al.

Nesting Chronology. Bald eagles in the Antelope nesting area initiate nesting during the first two weeks of March. Hatching follows by the end of the first or second week in April. Fledging occurs in early July, and the young depart for wintering areas in early September.

Occupied Nesting Zone, Zone 1. Five different nests have been used within this territory, including cottonwood and Douglas-fir trees. These nests have ranged in location from the river bottom to the top of conifer-covered slopes which separate the river bottom from agricultural bench lands. This versatility shown in nest location is also seen the foraging habitat used by the Antelope pair. Although most documented foraging by the territorial adults has occurred along the river adults have also been seen foraging in the sage communities along the benches above the river. In 1995, the adult male was observed flying directly from a perch near the nest tree due north to the dry sage brush bench above Table Rock, and appeared to be foraging for ground squirrels. A diversity of prey remains, including skunk, ground squirrel, fish, and waterfowl, have been collected below or in Antelope Creek nests.

Key Use Areas. Extensive 1987 adult observations when a radio-tagged Antelope Creek fledgling was monitored, and 1995 adult observations, contribute most significantly to defining this area (figure 4). Antelope adult eagles focus much of their foraging activity along the river corridor between Wolf Flat and the Spaulding Ranch. Throughout the nesting and brood-rearing period, the majority of adult sightings occurred on the south side of the river in sections 13 and 14 (R 41E.,T3N.). Use of both sides of the river has been observed, although cliff perches on the north side of the river were less used in the 1995 observations. The most notable change in human activity in the breeding area is on the river itself as recreational activity increases yearly. There is also a recently built home on the southside bench opposite

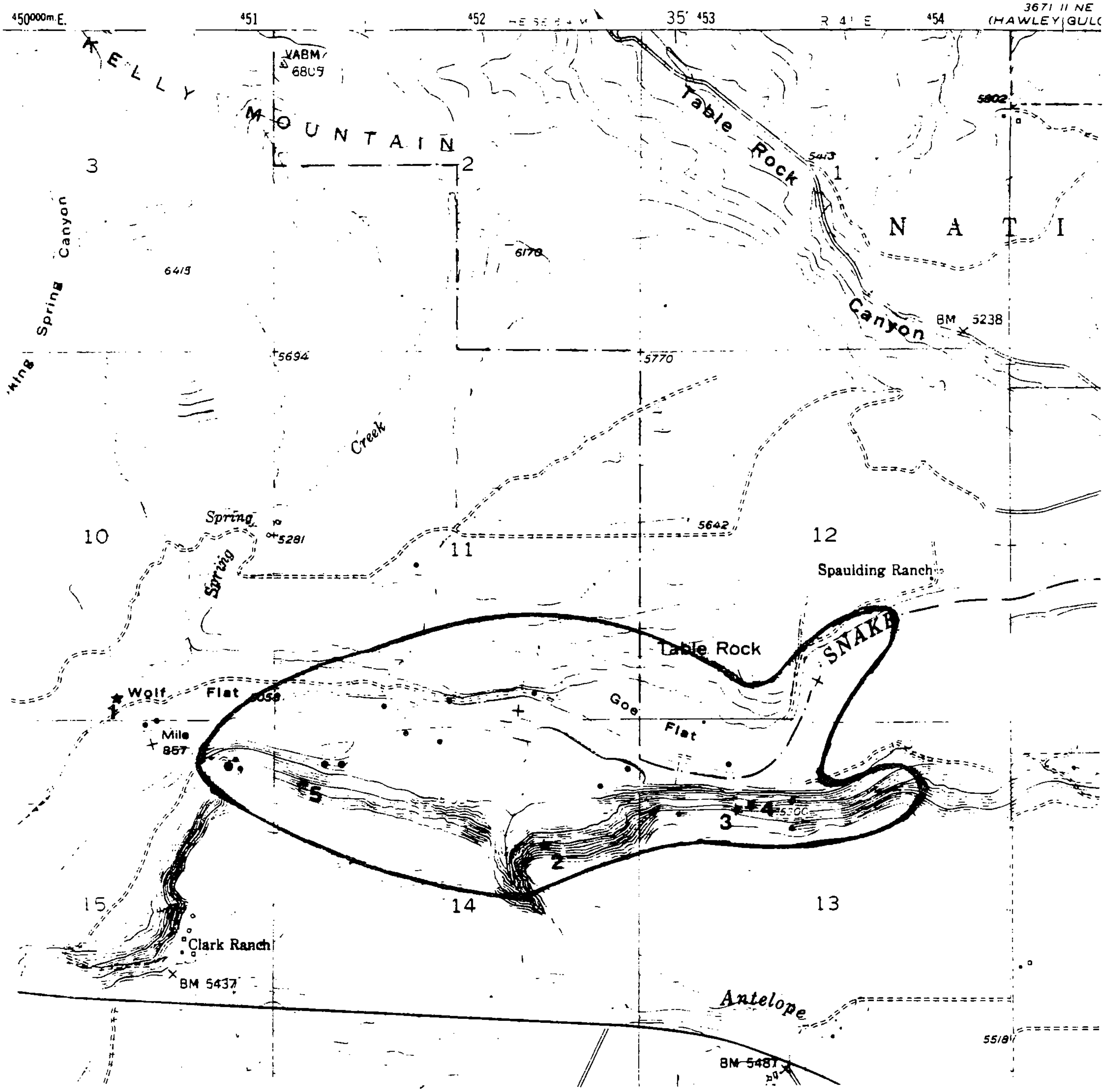


Figure 4. Known key use area within the Antelope Creek bald eagle breeding area, South Fork Snake River. Intensive monitoring has not occurred at this breeding area, and the information portrayed is preliminary only. The red line encloses the Principal Management Area. Numbers indicate known nest sites, numbered chronologically.

Breeding Area Habitat Quality. This river reach features relatively broad canyon bottoms with a considerable variety of available prey. Although multiple channels are found within the pair's home range, most of the favored foraging reach is along a single, large channel. However, the pair also forages in nearby uplands that feature a relatively high proportion of natural vegetation and potential prey. Recreational activity in this reach is relatively high, particularly along the South Fork road. The nest side of the river is as yet an undeveloped mix of native vegetation and cultivated land.

Menan Buttes 18-IS-20

Identification of key use areas was scheduled for this breeding area in 1995, but prolonged high water and difficult access forced us to substitute the St. Anthony Breeding Area in 1995.

St. Anthony 18-IS-15

Breeding Area History. K. Rice (pers. comm.), in her review of the original 1879 survey plat of the St. Anthony area, noted reference to Eagles Nest Ford on a road within Sec 10, R40E, T7N. This is the same section where the current St. Anthony bald eagle nest is located. In the early settlement history of this area, Eagle Nest Ford was often mentioned. A map prepared by the 1872 Hayden Survey noted the Ford. Richard "Beaver Dick" Leigh, an early resident of this area, made several references to this Ford as Eagle Nest Ford, Eagle Nest Crossing, or simply "Eagle Nest" in the 1870s (Thompson and Thompson 1982). In August, 1875, he sent a party up to the Ford to cross with a herd of cattle. In July, 1876, he referred to an old campsite at the crossing. In 1898 he wrote from Wilford in "Freemont County" that the county seat, St. Anthony, was at Eagle's Nest Crossing.

Table 7. Known productivity at the St. Anthony bald eagle breeding area since known establishment of the breeding area by bald eagles in 1984.[1]

YEAR	NESTING STATUS	NUMBER YOUNG FLEDGED	NEST NUMBER	COMMENT
1984	Active, Unsuccessful	0	Nest # 1	Nesting attempt in heron nest.
1985	Active, Unsuccessful	0	Nest #2	Early nest failure
1986	Unoccupied	0		May have been undetected in nest #3.
1987	Active, Successful	3	Nest #3	Three young banded 6/02/87.
1988	Active, Successful	3	Nest #3	Three young banded 5/28/88.
1989	Active, Successful	3	Nest #3	Three young banded 6/10/89.
1990	Active, Unknown	?	Nest #3	Incubating adult 3/30. No follow-up.
1991	Active, Successful	1	Nest #3	One nestling died early in cycle.
1992	Active, Successful	2	Nest #3	Banded 1 of 2 on 6/07/92.
1993	Active, Successful	1	Nest #3	High water year, no banding here.
1994	Active, Successful	2	Nest #3	Not banded.
1995	Active, Successful	1	Nest #3	High water year, not banded.

[1] Productivity data from records compiled by BLM and Idaho Dept. of Fish and Game for 1967-1983. Productivity data from 1983-present from agency reports and reports compiled by M. Whitfield et. al.

In the modern era, reestablishment of bald eagles within this breeding area was first noted in 1984. B. Jones of the BLM spotted an incubating adult in an old heron nest during an aerial survey. This nesting attempt was within the Upper St. Anthony heron rookery in Sec.11, R40E, T7N, and apparently failed early in the cycle. A second alternate nest in 1985 on the south side of the river in the NE 1/4, Sec.11, R40E, T7N also failed early, and M. Whitfield found no nest in this area in 1986 during a ground search. Since 1987 this pair has used nest #3 on an island in Sec 10, R40E, T7N. This interesting cottonwood nest is far from the bole of the tree on a large limb, and has survived for 8 years despite its seemingly precarious position.

Nesting Chronology. Although we do not have detailed observations of bald eagles in this breeding area early in the nesting period, our limited observations suggest that incubation is initiated in early March. M. Maj saw an incubating adult here on March 5, 1995. Nestlings have been relatively large when banded in late May/early June, suggestive of hatching dates in early April. The young were about 8 weeks of age when the site was visited June 7, 1992.

Occupied Nesting Zone, Zone 1. We define Zone 1 for this territory as the area within 400 m or 1/4 mile of each of the three known alternate nests (figure). This pair does become greatly agitated when people are on the south bank opposite the nest about m from the base of the nest tree.

Key Use Areas. Adult movements are difficult to monitor in this breeding area because of the dense cottonwood forest. Definitive analysis of breeding area use would require radio telemetry. Our limited observations suggest that the adults forage along the river in both directions from the nest (figure 5). We monitored adult and fledged juvenile activity in this area for approximately 15 hours of observations in 1995. An adult took a whitefish from the river 200 m downstream of the nest on 5/22, and made several foraging attempts in this area. Post fledging, both adults and the fledgling were repeatedly seen in perches near the 1985 nest site (figure). Foraging attempts were seen in the river at this location. This area is apparently favored for foraging, but probably experiences too much human activity to allow nesting in the area as evidenced by the early nesting failures here in 1984 and 1985.

Breeding Area Habitat Quality. The Henry's Fork in this area is braided into many channels with considerable foraging opportunity. The bottom land area on the south side of the river is popular for picnics and other recreational activities, but the nest tree itself is somewhat insulated from this activity by two small river channels. In recent years, high water has limited human activity in the area early in the nesting cycle. Programs that encourage human recreational activity in these bottom lands may conflict with bald eagle use of the area in the future. Conservation of this open space for wildlife should be a high priority given its close proximity to developed areas.

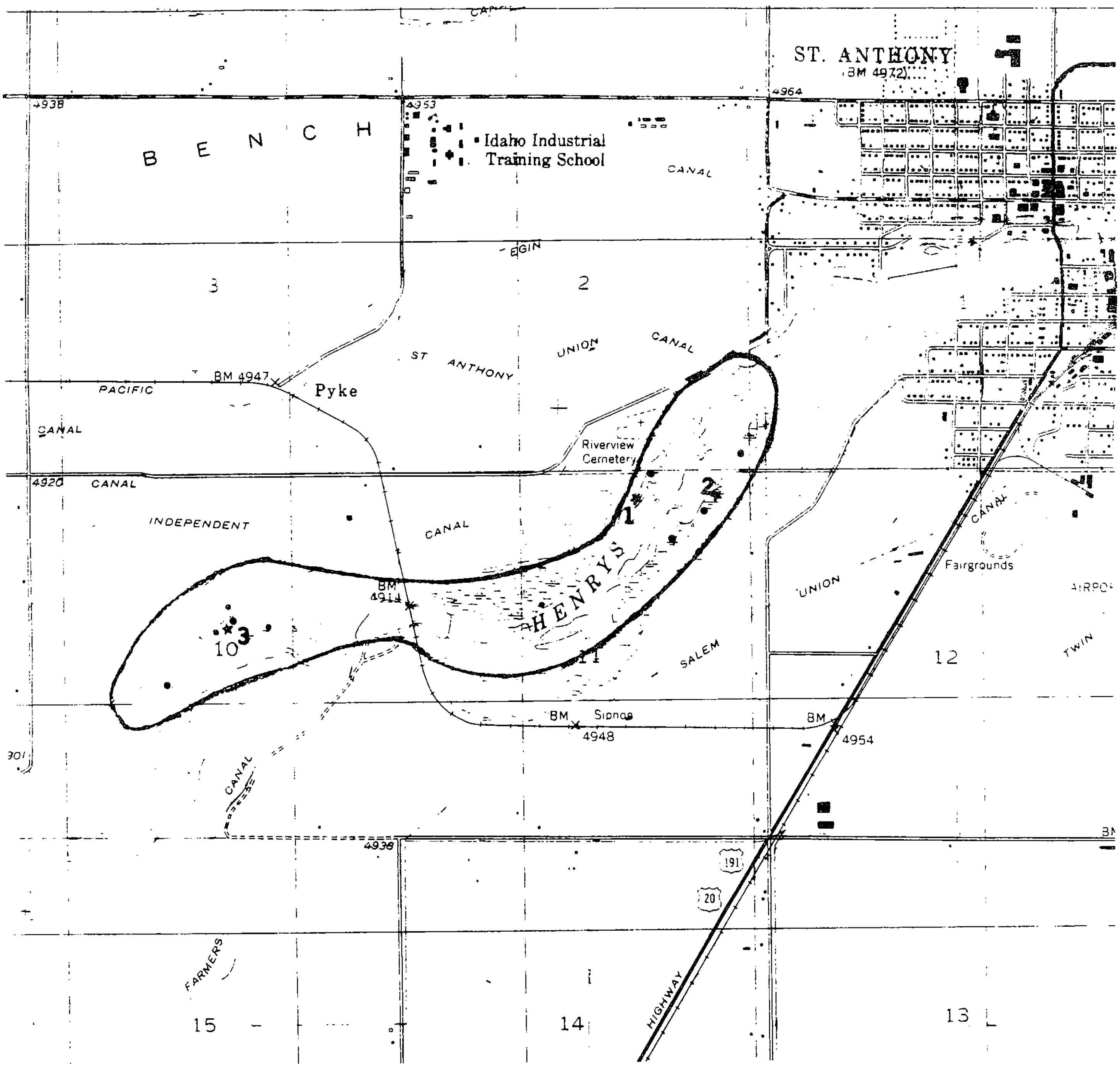


Figure 5. Known key use area within the St. Anthony bald eagle breeding area, Henry's Fork Snake River. Intensive monitoring has not occurred at this breeding area, and the information portrayed is preliminary only. The red line encloses the Principal Management Area. Numbers indicate known nest sites, numbered chronologically.

Raptor presence and habitat use.

In 1994 and 1995, we recorded presence/absence surveys in 437 randomly selected sample quadrats, with at least one raptor detected in 179 sample quadrats, and no birds seen in 258 sample quadrats (Appendix Table 2). We searched for 26 raptor species, and detected 17 raptor species within our sample areas. We have detected at least 3 more species in the area, but these species were not detected in sample areas in these sample years. Table 8 summarizes the raptor occurrences by general vegetative cover type.

Table 8. Summary of raptor observations (occurrence) by general vegetation type within the Snake River Study Area, 1994-1995.

Raptor Species	Macro Habitat (numbers refer to general vegetative cover type after Ulliman et al. 1991)										
	211	212	321	322	412	421	422	511	621	623	741
Ha.le.	2	2	2	0	0	7	0	3	0	46	1
Aq.ch.	0	0	6	0	0	0	0	0	0	0	1
Pa.ha.	0	0	0	0	0	1	0	0	0	2	0
Ac.ge.	0	0	0	0	0	1	0	0	0	0	0
Ac.co.	0	0	0	0	0	2	0	0	0	0	0
Ac.st.	0	0	0	0	0	1	0	0	0	0	0
Bu.ja.	2	0	8	0	3	7	0	0	0	16	0
Bu.sw.	2	0	0	0	0	1	0	0	0	5	0
Bu.re.	0	0	0	0	0	0	0	0	0	0	0
Ci.cy.	0	0	3	0	0	0	0	0	1	0	0
Fa.pe.	0	0	0	0	0	1	0	0	0	0	1
Fa.me.	0	0	1	0	0	0	0	0	0	0	0
Fa.co.	0	0	0	0	0	0	0	0	0	0	0
Fa.sp.	1	0	4	1	3	2	1	0	0	10	0
Ca.au.	1	0	2	0	0	0	0	0	0	1	1
Ae.ac.	0	0	0	0	2	4	0	0	0	0	0
Ot. fl.	0	0	0	0	0	4	0	0	0	0	0
As. ot.	0	0	0	0	0	2	0	0	0	0	0
Bu. vi.	0	0	0	0	1	6	0	0	0	5	0
% Area	35.14	2.12	18.31	1.36	9.44	8.19	3.14	4.62	0.87	6.92	0.53

We briefly discuss the sightings of each individual raptor species. Bald eagles were detected in 63 sample quadrats. Of this total, 46 were in cottonwood habitats, 2 over sagebrush, 3 over river, 7 in Douglas-fir, 2 over plowed fields, 2 over permanent pasture, and 1 in cliffs. Golden eagles were represented in 7 records, 5 over sagebrush-bitterbrush habitats, 1 over an upland grassland, and 1 over a cliff. Osprey were seen in 3 samples, 2 over cottonwoods and 1 in Douglas fir.

Among the accipiter hawks, we detected only 4 records, 1 goshawk, 2 of Cooper's hawk, and 1 sharp-shinned hawk. All of the observations were in Douglas fir. However, nest sites for goshawk and Cooper's hawk are known in cottonwood and aspen habitats within the study area, but outside the randomly selected quadrats.

Buteo hawks were relatively common. We detected nesting by red-tailed hawks and Swainson's hawks in cottonwood, aspen and Douglas fir habitats. Red-tailed hawks occurred in 36 quadrats, with 16 of these in cottonwoods, 8 over sagebrush, 7 in Douglas fir forest, 3 in aspen, and 2 over plowed fields.

Swainson's hawks were seen in 8 quadrats: 5 in cottonwoods, 2 over plowed fields, and 1 in Douglas fir. We did not observe ferruginous hawks in the study area.

We did note 4 records of harrier, or marsh hawks: 3 in sagebrush, 1 over willow. Outside of selected quadrats, we have detected nesting marsh hawks in CRP seeded grasslands on the river rim on three occasions.

Falcons were represented in 25 records. Peregrine falcons were detected in 2 records: 1 in Douglas fir (perch), 1 in cliffs. One of two known peregrine aeries within the study area fell within a sample quadrat. Prairie falcons were detected in only 1 record, over sagebrush. Outside of sample quadrats, we are aware of 3 prairie falcon aeries within the study area. We did not see any merlins in our observations in 1994-1995, although we have seen merlins in the study area on two earlier occasions. Kestrels occurred in 22 quadrats, 10 in cottonwoods, 4 over sagebrush, 3 in aspen, 2 in Douglas fir, 1 in juniper, 1 over plowed field, 1 in mountain mahogany. Kestrels were known to be nesting in cottonwoods and aspen.

Turkey vultures were detected in 5 quadrats, 2 over sagebrush, 1 over cliffs, 1 over plowed field, 1 in cottonwoods. These birds were seen soaring over a variety of habitats. We did not detect any nest sites.

Among the small owls, the northern saw-whet was most commonly detected. This species was heard singing in 6 records, 2 in aspen, and 4 in Douglas fir. We detected no northern pigmy owls in our samples, although we have seen and heard pigmys in Douglas fir habitats within the study area but outside our samples. Similarly, we did not detect any western screech owls despite many searches in sample areas, but have heard these owls in cottonwood habitats near Heise in earlier years. We did record 4 records of singing, and presumably nesting, flammulated owls, all in Douglas fir samples that featured mixed aspen.

Among the larger owls, great horned owls were relatively common and cosmopolitan in vegetative cover type. We noted 12 records, 1 in aspen, 6 in Douglas fir, and 5 in cottonwood. Known nest sites occur in cottonwood and Douglas fir habitats._Long-eared owls were noted in 2 records, both in Douglas fir, adjacent to sage stands. We also heard long-eared owls in cottonwood forests, but outside of sample quadrats. Fledged broods were seen on several occasions in Douglas fir and cottonwood forests. Short-eared owls were not detected in our samples, although we believe that they occur in open areas in the lower reaches of the study area.

We did not detect any great gray, barred, boreal, or burrowing owls in our study area. Great gray and boreal owls are known to occur near the area, but at higher elevations.

<u>Macro habitat selectivity.</u>

Eight species were seen frequently enough to allow analysis of macro-habitat selectivity in a contingency table (Appendix Table 3). All of these 8 species were significantly selective in their macro-habitat preferences (chi-square goodness of fit, p values <.001). Cottonwood, Douglas fir, and sageland habitats were used far more than expected under random association. Tilled cropland was the primary vegetative cover type in more selected samples than any other cover type (129 = 30% of samples, tilled cropland = 35% of total area), but represented only 4% of samples where raptors were detected. Two sagebrush dominated sample quadrats featured the greatest diversity of detected species, one with 4 species and another with 5 species. Raptors detected in sagelands were, for the most part, seen flying over the area and were assumed to be hunting rather than nesting.

Table 9. Contingency table for analysis of raptor occurrence by macrohabitat type, Snake River Study Area, 1994-1995.

		Macro Habitat Observed and Expected Values									
Raptor	Obs.	O	E	O	E	O	E	O	E	O	E
Species	n	211	211	212	212	321	321	322	322	412	412
Ha.le.	63	2.00	22.11	2.00	1.34	2.00	11.53	0.00	0.31	0.00	2.17
Aq.ch.	7	0.00	2.46	0.00	0.15	6.00	1.28	0.00	0.09	0.00	0.66
Bu.ja.	36	2.00	12.65	0.00	0.76	8.00	6.59	0.00	0.49	3.00	3.40
Bu.sw.	8	2.00	2.81	0.00	0.17	0.00	1.46	0.00	0.11	0.00	0.76
Fa.sp.	22	1.00	7.73	0.00	0.47	4.00	4.03	1.00	0.30	3.00	2.08
Ca.au.	5	1.00	1.76	0.00	0.11	2.00	0.92	0.00	0.07	0.00	0.47
Ae.ac.	6	0.00	2.11	0.00	0.13	0.00	1.10	0.00	0.08	2.00	0.57
Bu. vi.	12	0.00	4.22	0.00	0.25	0.00	2.20	0.00	0.16	1.00	1.13
% Area		35.14		2.12		18.31		1.36		9.44	

Raptor	O	E	O	E	O	E	O	E	O	E	O	E	Sum of	
Species	421	421	422	422	511	511	621	621	623	623	741	741	Chi Square	p-value
Ha.le.	7.00	1.88	0.00	1.98	3.00	2.91	0.00	0.55	46.00	4.36	1.00	0.33	444.49	0.0000
Aq.ch.	0.00	0.57	0.00	0.22	0.00	0.32	0.00	0.06	0.00	0.48	1.00	0.04	45.46	0.0000
Bu.ja.	7.00	2.95	0.00	1.13	0.00	1.66	0.00	0.31	16.00	2.49	0.00	0.19	92.72	0.0000
Bu.sw.	1.00	0.66	0.00	0.25	0.00	0.37	0.00	0.07	5.00	0.55	0.00	0.04	39.64	0.0000
Fa.sp.	2.00	1.80	1.00	0.69	0.00	1.02	0.00	0.19	10.00	1.52	0.00	0.12	57.17	0.0000
Ca.au.	0.00	0.41	0.00	0.16	0.00	0.23	0.00	0.04	1.00	0.35	1.00	0.03	35.66	0.0001
Ae.ac.	4.00	0.49	0.00	0.19	0.00	0.28	0.00	0.05	0.00	0.42	0.00	0.03	33.12	0.0003
Bu. vi.	6.00	0.98	0.00	0.38	0.00	0.55	0.00	0.10	5.00	0.83	0.00	0.06	54.60	0.0000
% Area	8.19		3.14		4.62		0.87		6.92		0.53			

Raptor nesting observations.

Our emphasis for the first two years of the raptor inventory has been presence/absence surveys. We have not begun structured nest searches nor attempted to monitor productivity, with the exception of the bald eagle work, a separate, specific objective.

Our incidental nest observations include: Red-tailed hawks in cottonwood and Douglas fir habitats, Swainson's hawks in cottonwoods, Goshawks in aspen and Douglas fir, Cooper's hawk in cottonwood, numerous Kestrels in cottonwoods and aspen, Long-eared owls in Douglas fir forests in Blacks and Dry Canyons, Great-horned owls in cottonwoods at four locations, 1 young in a cliff site at the confluence, and fledged broods in Douglas-fir in upper river areas; Flammulated owls in a mix of Douglas fir and aspen.

Garner et al. (1995) reported six raptor nests in the Snake River Study area: 1 Sharp-shinned hawk, 1 Cooper's Hawk, 3 Kestrels, and 1 Long-eared Owl, all in cottonwood riparian forest habitats.

Raptor Habitats and Land Use Activities: Effects and Management Recommendations

Although most of the habitats used by birds of prey in the western United States have been altered by land use activities, little quantifiable information has been collected on the effects, particularly long term effects, of human activities and habitat modification. It is difficult to accurately measure the cause and effect relationships of cumulative actions under field conditions, and isolation of a single factor requires control of many variables. With recognition that vast resources are needed to gather and rigorously test data on activity impacts and to monitor the effects of management actions, we provide the following synthesis of published information, with associated management recommendations.

Two important sources we used are - *Ecology and Management of Neotropical migratory birds* edited by T. E. Martin and D. M. Finch and *Proceedings from the western raptor management symposium and workshop* published in 1989 and made available by the National Wildlife Federation. Our summary presents information on potential, negative effects that we believe are relevant to the South Fork of the Snake River study area. Information is grouped by management activities and not by raptorial species. We believe this format is best suited to eliminate redundancy. Humans affect raptors by modifying (may be positive or negative) habitat, disrupting their normal behavior and by causing direct mortality of eggs, young or adults by such means as poisoning, shooting and electrocution. Habitat modification may be viewed as a two edged sword: whereas some species are negatively impacted by a set of changes, others may benefit.

Domestic Livestock Grazing

Modification and loss of vegetation affecting raptor nesting, foraging or security habitats. The Snake River study area features a relatively wide riparian cottonwood corridor within a large expanse of shrub steppe and agriculturally modified habitat. Unlike the grasslands of North America, western shrub steppe habitat in the Intermountain West did not co-evolve under the influence of large herds of grazing animals. Shrub steppe plant communities are not thought to be adapted to withstand continuous, severe grazing pressures. Intensive grazing of livestock can reduce overall plant species composition, structure and diversity, decrease site moisture and increase soil compaction. Domestic livestock grazing has also played a role in the introduction of exotic plants and subsequent reduction of forb cover (Saab et al. 1995). Extensive plantings of crested wheatgrass, which was introduced as livestock forage throughout the western United States, has resulted in reduced diversity and density of raptors through the reduction of their prey (Sharp 1986). Overgrazing, along with drought and fire suppression, are identified as major causes of the loss of native grasses (perennial and native seral species) and consequent increases in shrub and tree (juniper) cover, specifically sagebrush in the Intermountain West (Littlefield et al. 1984; Woodbridge 1991). This increase in shrubs comes about as palatable herbaceous plants are selectively removed by grazing animals and less palatable, shrubby plants are thus given an advantage. It is primarily through these habitat related changes that birds of prey are affected (Woodbridge 1986).

Domestic livestock grazing in riparian areas affects the composition and structure of vegetation as mentioned above. Intensive grazing can actually reduce or eliminate riparian areas through channel widening and lowering of water tables (Platts 1991). Many believe that the fragmented and limited distribution of riparian habitat in the west makes them and the species that inhabit them particularly vulnerable to impacts such as grazing (Terborgh 1989).

There is little information about domestic livestock grazing in coniferous forest (Saab et al. 1995). One clear effect is the loss of savanna-like forest. Grazing along with fire suppression has eliminated low intensity, under story fires that once were of significant influence on forests in the western United States. Some believe that grazing has resulted in increased tree density, reduction of herbaceous and shrubby under stories and expansion of conifer trees into surrounding meadow, grassland, shrub and aspen habitats.

Most species experience long term negative effects from overgrazing. Effects depend upon the type, intensity, timing and location of grazing in the context of the individual raptor species. This is particularly true in riparian habitats.

Loss of native grasses within shrub steppe habitats is particularly detrimental to species that are ecologically linked to grassland habitats such as ferruginous hawks (*Buteo regalis)*, northern harriers (*Circus cyaneus*), prairie falcons (*Falco mexicanus),* Swainson's hawk *(Buteo swainsoni)* and golden eagle (*Aquila chrysaetos).* The decline of Swainson's hawk in northern California and eastern Oregon can be attributed to this change from grassland to sagebrush communities (Littlefield et al. 1984, Sharp 1986, and Woodbridge 1991).

Ground nesting birds such as northern harriers can be directly impacted through trampling. Eggs and young birds, either ground nesting or those that have left the nest but remain on the ground, are vulnerable to increased predation as nest cover is reduced. Intensive grazing that changes plant composition and vegetation height and density can also result in changes to the small mammal and bird communities and their availability as prey (Feldhamer 1979, McGee 1982). Increases in shrub cover at the expense of herbaceous cover are favorable to production of jackrabbits, a primary prey for golden eagles and ferruginous hawks in some areas. However, ferruginous hawks have also shown negative responses to intensive grazing which reduced herbaceous cover and changed prey abundance (Kochert 1989, Woffinden and Murphy 1989). Again, this alludes to the specificity of grazing effects to specific areas and species. The effects of heavy grazing appear most tolerated by birds and small mammals that are granivorous and less tolerated by those that rely on a diversity of perennial forbs and grasses for food and cover (Kochert 1989). A good example of this shift under heavy grazing is the reduction of *Microtus spp.* (voles), a species active during the daytime and an increase in *Peromyscus spp.* (deer mice) a species active during the nighttime. The shift from one species to another is not always clear and predictable, because associations between small mammal population density and habitat condition are dynamic through time and space (Synder and Best 1988). An important point here is that grazing can directly affect birds of prey through changes in their prey base. This is particularly important for those raptors that have narrow food niches.

Long term modification of vegetation composition and structure.. Of particular concern is the loss of trees and shrubs used for nesting due to intensive grazing pressure. Small stands of trees that are solitary or isolated by surrounding open areas may receive high livestock use for shading, rubbing and forage. These same stands are equally important to tree and cavity nesting raptors such as kestrels (*Falco sparverius),* saw-whet owls (*Aegolius acadicus),* red-tailed (*Buteo jamaicensus)* and Swainson's hawks (*Buteo swainsoni).* Some of the aspen stands on the benches above the South Fork of the Snake River, which are inhabited by northern goshawk

(*Accipiter gentilis*) and kestrels, are an example of this situation. Abrasion, herbivory and trampling concentrated in small aspen stands can cause the death of nesting trees and eliminate young regeneration that provides future nesting habitat (Olendorff and Stoddart 1974). Early season grazing followed by removal of livestock allowing for plant regrowth appears to be a preferred system of use in riparian areas, as is late fall and winter grazing. Studies which address season of livestock grazing in cottonwood areas show variable results in the resilience of shrubs and cottonwood seedlings. Authors warn that these studies may be too short term to draw conclusions (Glinski 1977, Sedgwick and Knopf 1991).

Sources of direct mortality - trampling, shooting, trapping and poisoning. Trampling of eggs or young, flightless birds may occur with ground nesting species such as northern harriers and short-eared owls. Persecuted as predators, shooting of raptors has occurred throughout the United States and has probably had significant effects on individual populations. Loss of birds of prey as a secondary target to trapping still occurs, but is less of an impact than in the past when trapping was more generally targeted for scavenging animals, such as bears and coyotes, without consideration to non-target species. Another cause of secondary loss is from insecticides used on livestock such as Warbex. This oraganophosphate insecticide, which is poured onto livestock to control grubs, has toxic ingredients which persist for 90 days unabsorbed and have become available and fatal to raptors (USFWS 1986).

Conclusions and Management Recommendations. The most meaningful management recommendation is to follow the Bureau of Land Management's internal direction to maintain properly functioning grassland, riparian and rangeland habitats (BLM 1994). Focus upon the functional health of an ecological area or habitat will meet the needs of individual plants and animals evolved within that zone, and avoids the possibility of managing for one species at the cost of another. Use of domestic livestock as a vegetation management tool is encouraged, rather than grazing solely for production of red meat and wool. Solutions to overgrazing are best addressed on an area specific basis. Solutions may include reduction in numbers of grazing animals, change in season of use, or elimination of grazing from certain areas. Careful monitoring of implemented management strategies is needed to determine grazing impacts.

Despite a lack of overall information on grazing effects, a thorough literature review by Saab et al. (1995) revealed that birds which inhabit lower levels of vegetative structure consistently declined in grazed habitats. Northern harriers and short-eared owls (*Athene cunicularia*), both found within the Snake River study area, fall in this category.

The recently published Northern goshawk management recommendations for the Southwestern United States recommend that livestock grazing not exceed 40% of grasses and forbs and 60% for shrubs. These utilization standards are recommended as a way to protect goshawk habitats and principle prey species. Preferred goshawk habitats are found in and around late seral forests.

At this time there is no clear evidence that domestic livestock grazing is affecting the recruitment of cottonwood trees along the South Fork of the Snake River, Idaho (M. Merigliano, pers. comm.). These trees provide important nesting habitat for raptors. It is suggested that following years of good cottonwood recruitment, measures should be taken to keep domestic livestock out of areas where young shoots occur. Some authors have suggested that small groves of trees and shrubs used for nesting be fenced out of a grazed pasture to ensure protection of standing trees and replacement trees (Olendorff and Stoddard 1974). Restoration may be needed in some areas to reestablish native bunch grasses and forb communities. Introduction of exotic plants for the purpose of enhancing livestock forage should be stopped. Grazing management plans should be designed around the management needs of riparian areas and other sensitive habitats. Often grazing systems, season of use and numbers are determined on the basis of upland habitat, with little consideration given to more sensitive sites like wet meadows, riparian habitats or isolated stands of aspen. Late season grazing, fencing and rest rotation are all strategies employed to protect against overgrazing in riparian habitat. It is believed that these grazing strategies have lesser negative effects on small mammals and birds.

The solution to potential trampling is to manage a diversity of habitats so that healthy populations of raptors can survive, even though incidents of trampling may occur. Public education and law enforcement are key to reducing intentional shooting of birds of prey. Public attitudes change slowly. There are recent cases of birds of prey being shot along the Snake River. In some local areas, shooting may still be an important factor holding back local raptor populations. Trapping and aerial shooting of livestock predators is under the administration of APHIS therefore, neither activity should pose a problem to raptors. Numerous public laws protect raptors, such as the Migratory Bird Treaty Act, eagle protection acts and Endangered Species Act.

Timber Management

Most studies of silvicultural treatment effects on wildlife have occurred at the stand or sale area level, usually an area of less than 200 acres. Such studies often focus on the individual nest stand itself. Few studies have looked at the effects of timber management within the context of an entire wildlife community or species population, or even a watershed of a few 1,000 acres. Focus upon too small an area misses overall effects on a population's productivity and recruitment, because a narrow focus may miss effects on habitats needed for foraging, post-fledging cover, or other uses. Several features of raptor ecology add to the difficulty of attaining useful information on habitat needs (Thompson et al. 1995). Raptors are often secretive and most are highly mobile. Many raptor species have concurrent need for a variety of habitats. For example, an accipiter hawk may use an interior forest habitat for nesting and clearings or forest edges for foraging.

Silvicultural practices alter habitat by altering stand structure and size, age class, species composition, and edge ratios. These alterations affect raptor nesting, foraging and post fledging habitats (McCarthy et al. 1987, Reynolds et al. 1992, Hayward and Verner 1994). Silvicultural practices, other than clearcutting, are generally preferred for raptor habitat management since there are typically less dramatic changes to the understory, greater retention of nest trees, and quicker return to the structural characteristics of the original stand. Clearcuting has been identified as providing habitat for pocket gophers (*Thomomys talpoides*) and ground squirrels (*Spermophilus spp.*) which are important prey items for great gray owls (*Strix nebulosa)*, red-tailed hawks and numerous other raptors (Franklin 1987). The Forest Service uses rodenticides such as strychnine to eliminate species such as pocket gophers, which can seriously damage reforestation efforts in clearcuts. However, such poisons may present a serious threat of secondary poisoning for raptorial species that forage in treated areas

(Anthony et al. 1984). It is advised that toxic rodenticides not be used in raptor habitats, particularly within one mile of known raptor nests.

Generally, new roads must be built to access timber treatment areas. These roads result in increased human access, and potentially, disturbance. Some forest raptors in the study area initiate nesting when roads are still snow covered. These roads may then become passable at times coincident to incubation and brood rearing periods. Nest abandonment and lower fledging success have been observed from this type of disturbance (Call 1978, Whitfield 1993). Many birds of prey are least tolerant of disturbance during site selection, egg laying and the incubation periods (Stalmaster et al. 1982, McCarthy et al. 1987).

Timber harvesting has contributed to the alteration of over 95% of the original forest land in the United States (McCarthy et al. 1989). However, timber cutting and other treatments have not been a major impact in most of the study area. Few forest stands have been cut has on Bureau of Land Management lands within the study area. These include some trespass cutting of mature cottonwood. Several lodgepole pine and Douglas fir stands on National Forest and private lands in the upper portions of the study area have been cut in recent years. Lodgepole pine and Douglas-fir have been the targeted species for harvest on Forest Service and private lands in the area. Most of the clearing that took place in the past occurred on private lands when agricultural lands were opened up and homesteads were built. The upcoming Targhee National Forest plan will extend harvesting and fire treatment to aspen communities, which to date have not typically been harvested.

A significant impact from traditional timber management activities is the long-term conversion of late to early successional forests. Once cut, most stands are managed on a short rotation period, which never again allows the stand to reach a late successional stage. This is of concern for some of the more rare and specialized birds of prey in the study area such as northern goshawk, bald eagles (*Haliaeetus leucocephalus*), great gray, boreal (*Aegolius funereus*) and flammulated owls (*Otus flammeolus*), which are associated with late successional forests. This is also a concern for all the small owls and kestrel, which are cavity nesting birds. These raptors are obligate cavity nesters and depend upon older trees in which cavities are located. Birds of prey such as great horned owls (*Bubo virginianus*) and red-tailed hawks have wider ecological tolerances and are more likely to benefit from timber management activities.

Conclusions and Management Recommendations. Recently published management plans on the northern spotted owl (*Strix occindentalis*) and northern goshawk have provided the most current thinking on management for forest dependent raptors. Timber harvesting, which is known to have been a significant factor in the decline of both species, is thoroughly addressed. Management recommendations are set in the context of the overall ecology of the habitats these species apparently require. Although these management plans have been developed for geographic areas other than our own, the northern goshawk management strategy is being applied throughout the Intermountain West, with some modifications.

Specifics taken from the northern goshawk management recommendations (Reynolds et al. 1992) include: maintain three suitable nest areas within a breeding area equaling 30 acres per site. In addition, three replacement nest areas are to be maintained. All six areas are to be managed as mature and older forest stands, where no adverse actions (to goshawks) can take place. Post-fledging areas of 420 acres are managed for a variety of prey and forest conditions. Timber harvesting, fire and other treatments are allowed as long as they contribute to goshawk habitat needs and occur from October through February. Foraging areas of 5,400 acres are managed with similar objectives to post-fledging areas and for a variety of habitat conditions. The exact percentages of forest age classes varies with habitat types. The Targhee National Forest proposes to follow these guidelines under their revised Forest Plan. The strength of both documents is that they address species needs from the nest to post-fledging habitat and that they propose landscape management to mimic natural diversity.

Few other works provide a reasonable template for managing a full community of forest raptors. There are numerous good works that address individual species and their ecological needs. Each species and forest type requires an individual approach. Overall, recent thinking is moving away from a species by species management approach to a community approach, where landscapes are managed within their known ecological ranges and trends. This approach, referred to as Ecosystem Management (EM), requires a understanding of the history of the landscape. Management objectives are still dictated by desired conditions. Under this approach, managers assume that the wildlife occurs and behaves in the same habitats today as they did historically. It is also recommended by many observers that land management should give special attention to keystone, rare or specialized species. This is particularly true in monitoring the effects of land management activities. We suggest that birds of prey of the forested areas of the study area that fit the category of keystone, rare and specialized are bald eagles, goshawks and flammulated owls.

Maintenance of cavity nesting habitats requires that managers go beyond provision of a few standing snags within a clearcut. Stands should be managed for long-term recruitment of snags and older trees in which cavities develop or will be excavated within a broader context of adequate roost, foraging, and post-fledging habitats.

Recreational Activities and Human Disturbance

Some of the most ubiquitous and difficult effects to measure on wildlife are from human disturbances such as recreational activities. The effects of recreational activities on wildlife are often subtle and difficult to quantify. Individual events may appear benign, but have serious cumulative, synergistic and long-term impacts (Holmes et al. 1993, Anthony et al. 1995, Gutzwiller 1995).

Impacts associated with recreational disturbance and long-term human presence include: loss or modification of nesting and foraging habitat, introduction of non-native species which carry disease or act as predators (e.g. raccoons), increased occurrence of species that compete for nest sites (e.g. Canada geese, corvids), increased chance of electrocution, persecution (shooting), impact with structures (e.g. fences, powerlines and vehicles), toxic material poisoning, and changes in normal behaviors. Individual animals respond in various ways including: changes in their home range, increased energy use, decreased foraging efficiency, poor adaptation to new sources of predation, altered habitat use and behavior. Energetics are affected when birds fly to avoid disturbance and when they shorten foraging bouts or avoid optimal foraging habitats. Examples of this have been observed on the South Fork of the Snake River where boating, fishing and other recreational activities have been factors in determining bald eagle activity patterns and distribution during periods of extremely high human activity (Whitfield 1993). Bald eagles responded to the high fishermen activity during trout fly hatches by moving to alternate foraging sites and perching greater distances from the river. Ultimately, productivity and survival are lowered (Anthony et al. 1995). Juvenile birds may be more vulnerable to these negative impacts since they have greater energy demands, less experience, and greater vulnerability due to their size, physiology and anatomy (Craig et al. 1988).

An individual birds experience with human persecution and factors like position in the landscape (e.g. perched versus on the ground) weigh into the variable responses seen by birds of prey to human activities (Knight et al. 1989, Knight and Cole 1991). Raptors that use areas with high levels of disturbance (e.g. along roadsides) show greater tolerance to disturbance than do birds in areas with lower levels of activity, thus illustrating some ability to habituate (Fraser et al. 1985, Buehler et al. 1991). Repetitiveness (= predictiveness) and length of time the disturbance occurs influence a bird's response and habituation.

Management Recommendations. Buffers which separate human disturbances from raptor focal points, such as nests, have been a traditional and effective management tool (Knight and Skagen 1988, Stalmaster 1987, Reynolds et al. 1992). Spatial and temporal buffer zones have been used to reduce or eliminate impacts from human disturbances. Spatial buffers are typically used around discrete areas such as nest sites and roosts. Buffer zones and timing restrictions need to be designed specific to the species and situation since there are substantial differences in response (Holmes et al. 1993). Numerous sources provide dates and dimensions for temporal and spatial buffers, respectively (Whitfield et al. 1995, Harmata 1991, Suter and Joness 1981).

Spatial buffers are already in place around bald eagle nests in the study area. They serve an important purpose and are necessary even though the current bald eagle population is growing exponentially. Recreational uses continue to increase and diversify within the study area, to the point that some areas are no longer suitable bald eagle habitat. Restrictions on human activities around sensitive sites are likely to be needed well into the future.

No other restrictions are currently in place for the protection of raptors in the study area, and do not seem necessary at this time. Discretion in the release of information on sensitive species locations is one way to minimize the potential for disturbance.

Energy and Minerals Development

Oil and gas development is the most likely type of energy resource development to take place within the study area. Fragmentation of habitats by roads, loss of habitat, potential of electrocution, noise, toxic gas pollution and increased human disturbance are among impacts posed by oil and gas developments (Postovit and Postovit 1989). Overall, there is usually an increase in human interaction with raptors and their habitat.

Seismic work can have direct impacts on birds of prey, though impacts are generally short-term. Additionally , negative effects can often be adequately avoided by directing the seismic activity away from sensitive areas or scheduling the disturbance during an non-critical period. Human disturbance is highest during exploration and habitat loss is greatest during the drilling phase when pads and roads are developed (Postovit and Postovit 1989). The significance of cumulative impacts is often lost, since detailed, intensive project analyses are usually carried out at the individual "permit to drill" phase, and not over entire fields or a watershed. Since top soils are rarely saved for reclamation, long term impacts to habitat and, subsequently to prey, occur. Golden eagles, merlins, ferruginous hawks and northern harriers, all grassland species, have shown variable responses to oil and gas development (Suter and Joness 1981, USDI 1987, Van Horn 1993, Harmata 1991). In all cases, however, buffers are still encouraged as a method of mitigating serious impacts. Long term impacts are less understood.

Conclusions and Management Recommendations. Most management recommendations focus on the use of spatial and temporal buffers. "No surface occupancy" stipulations are another management strategy applied primarily for threatened or endangered species. Buffer distances vary by species, landscape and permitting stage (exploration versus development). Recommended buffer zones range between .5 and 1.6 mile (1 km) in distance around active nests during the general period of March 1 to August 1. These dates may vary by up to a month depending on the species, the stage of work and the location of project (latitudinal and altitudinal differences). Buffer zones are generally applied around nest sites, cliffs or other specific raptor locations like roosts and to nests or territories that are or have been recently active (<6 years). In the past many of these recommendations have been applied only during exploration and development. It is important that protective recommendations, where they apply, also be required during the production phase of work.

Agricultural Practices

Agriculture within the Rocky Mountain west is a relatively minor land use compared to other places across the United States. However, more lands within the study area have been impacted by agricultural practices than any other activity to date. Potatoes, hay and grains are the primary cultivated crops produced along the river corridor, whereas many private lands are in pasture. The negative effects of agricultural practices on raptors include modification of foraging and nesting habitat, exposure to pesticides, human disturbance, persecution, reduction of some prey species, reduced prey availability due to tall vegetation, occasional dewatering of natural waterways for irrigation, and increased predation from species that are habituated to human presence (Sharp 1986). Agricultural practices that benefit some raptors are increased nesting habitat in shelterbelts, increased prey and prey habitat (Olendorff 1973, Bloom 1980, Schmutz 1984, Bechard et al. 1986). For example, Swainson's hawks often focus foraging activity in hay fields, particularly after cuttings.

Ground nesting species, such as ferruginous hawks, and prairie falcons, which require expansive native landscapes for foraging, may be strongly impacted by conversion of native vegetation to agriculture (Snow 1974, Young 1989, Olendorff 1993). Insectivorous raptors such as flammulated owls, Swainson's hawks and kestrels are vulnerable to pesticide poisoning. Rodent and small mammal habitat can change dramatically under agricultural practices. Raptors with narrow food niches are more likely to be impacted by these changes, because they do not adjust as readily to changes in prey base.

Conclusion and Management Recommendations. Private landowners who wish to manage their agricultural land to benefit raptors might consider these recommendations:
(1) Avoid complete consolidation of agricultural fields through elimination of interspersed natural landscapes.

(2) Maintain or create windbreaks / shelterbelts using native trees and shrubs for nesting and roosting habitat.
(3) Minimize tilling land and leave fields in stubble between planting seasons to maintain small mammal habitat and reduce soil erosion (Young 1989).
(4) Avoid using pesticides that are indiscriminate and potentially toxic to non-target species such as insect eating raptors.
(5) Lands managed in the Conservation Reserve Programs (CRP) should be planted with native grasses and forbs.
(6) Vegetation along low lying irrigation systems creates oases of dense vegetation and good small mammal habitat.

References

Anthony, R.M., G.D. Lindsey, and J. Evans. 1984. Hazards to golden-matled ground squirrels and associated secondary hazard potential from strychnine for forest pocket gophers. Pp. 25-31 *in* (D.O. Clark, ed.). Proc. 11th Vertebr. Pest Control Conf. Davis, Calif.

Anthony, R. G. and F. B. Issacs. 1989. Characteristics of bald eagle nest sites in Oregon. J. Wild. Mgmt. 53: 148-159.

Anthony, R.G., R.J. Steidl, and K. McGarigal. 1995. Recreation and bald eagles in the Pacific Northwest. Pp. 223-241 *in* Wildlife and Recreationists: coexistence and management. (R.L. Knight and K.J. Gutzwiller eds.). Island Press, Washington D.C.

Bechard, M.J., K.D. Hague-Bechard, and D.H. Porter. 1986. Historical and current distribution of Swainson's and ferruginous hawks in southern Idaho. Boise State Univ., Dep. Biol., Boise, Id. 58 pp.

Bloom, P.H. 1980. The status of the Swainson's hawk in California, 1979. Cal. Fish and Game Nongame Wildlife Investigations, Job II-8.0. 42 pp.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and K.D. Seegar. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. J. Wildl. Manage. 55:282-290

Brown, L. H. and D. Amadon. 1968. Eagles, hawks and falcons of the world. McGraw-Hill, New York, Two vols., 945 pp.

Call, M.W. 1978. Nesting habitats and surveying techniques for common western raptors. U.S. Dept. Inter., Bureau Land Manage. Tech. Note 316. 117 pp.

Craig, R.J., E.S. Mitchell, and J.E. Mitchell. 1988. Time and energy budgets of bald eagles wintering along the Conneticut River. Journal of Field Ornithology 59:22-23.

Feldhamer, G.A. 1979. Vegetative and edaphic factors affecting abundance and distribution of small mammals in southeast Oregon. Great Basin Natur. 39:207-218.

Franklin, A.B. 1987. Breeding biology of the great gray owl in southeastern Idaho and northwestern Wyoming. Thesis. Humbolt State University, Arcata, California. 83 pp.

Fraser, J. D., L. D. Frenzel, and J. E. Mathisen. 1985. The impact of human activities on breeding bald eagles in North-Central Minnesota. J. Wild. Mgmt. 49:585-592

Greater Yellowstone Bald Eagle Working Group. 1983. A bald eagle management plan for the Greater Yellowstone Ecosystem. Wyoming Game and Fish Dept., Cheyenne, 84 pp.

Greater Yellowstone Bald Eagle Working Group. 1993. Productivity report for 1993. Yellowstone National Park, Mammoth, pp.

Grubb, T. G. An evaluation of bale eagle nesting in western Washington. Pp 87-103 in R.L. Knight, G.T. Allen, M.V. Stalmaster, and C.W. Servheen (eds.) Proceedings of the Washington Bald Eagle Symposium. Wash. Dept. Game, Olympia, WA.

Gutzwiller, K.J. 1995. Recreational disturbance and wildlife communities. Pp 169-181 *in* Wildlife and Recreationists: coexistence and management. (R.L. Knight and K.J. Gutzwiller eds.). Island Press, Washington D.C.

Harmata, A.R. 1991. Impacts of oil and gas development on raptors associated with Kevin Rim, Montana. Bur. Land Manage., Great Falls, MT. 77 pp + Appendices.

Harmata, A. and B. Oakleaf. 1992. Bald eagles in the Greater Yellowstone Ecosystem: an ecological study with emphasis on the Snake River, Wyoming. Wyoming Dept. Game and Fish, Cheyenne, 232 pp.

Hayward, G.D. and J. Verner, Tech. Editors. 1994. Flammulated, boreal and great gray owls in the United States: A technical conservation assessment. Gen Tech. Rep. RM-253. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 214 pp . 3 maps.

Henny, C. J. 1983. Distribution and abundance of nesting ospreys in the United States. Pp. 175-186 in Bird, D. M., N. R. Seymour, and J. M. Gerrard eds., Biology and Management of Bald Eagles and Ospreys, Raptor Res. Found., Harpell Press, Ste. Anne de Bellevue, Quebec, 325 pp.

Herrick, F. H. 1932. Daily life of the American eagle: early phase. Auk 49:307-323.

Holmes, T.L., R.L. Knight, L. Stegall, and G.R. Craig. 1993. Responses of wintering grassland raptors to human disturbances. Wildl. Soc. Bull. 21:461-468.

Knight R.L., and S.K. Skagen. 1988. Effects of recreational disturbances on birds of prey: a review. Pp. 355-359 *in* (R.L. Glinski, B.G. Pendleton, M.B. Moss, M.N. LeFranc, Jr. B.A. Millsap, and S.W. Hoffman eds). Proc. of the southwest raptor management symposium and workshop. Natl. Wildl. Fed. Washington, D.C.

Knight, R.L., D.E. Andersen, M.J. Bechard, and N.V. Marr. 1989. Geographic variation in nest defense behavior of the red-tailed hawk *Buteo jamaicensis*. Ibis 131:22-26.

Knight, R.L., and D.N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. Trans. North Am. Wildl. And Nat. Resour. Conf. 56:238-247.

Kockert, M.N. 1989. Responses of raptors to livestock grazing in the western United States. Pp. 194-203 *in* (R.L. Glinski, B.G. Pendleton, M.B. Moss, M.N. LeFranc, Jr. B.A. Millsap, and S.W. Hoffman eds). Proc. Western Raptor Manage. Symp. Workshop. National Wildlife Federation, Washington, D.C.

Lincer, J. L., W. S. Clark, and M. N. LeFranc. 1979. Working bibliography of the bald eagle. National Wildlife Fed., Washington, D. C., 244 pp.

Littlefield, C.D., S.P. Thompson, and B.D. Ehlers. 1984. History and present status of Swainson's hawk in Southeastern Oregon. Raptor Res. 18:1-5.

McCarthy, C., W.D. Carrier, and W.F. Laudenslayer. 1989. Coordinating timber management activities with raptor nesting habitat requirements. Pp. 229-235 *in* Proc. Western Raptor Manage.. Symp. Workshop. National Wildlife Federation, Washington, D.C.

Martin, T.E. and D.M. Finch. 1995. Ecology and management of neotropical migratory birds - A synthesis and review of critical issues. 489 pp.

McGee, J. M. 1982. Small mammal populations in an unburned and early successional sagebrush community. J. Range Manage.. 35:177-180

Olendorff, R.R. 1973. The ecology of nesting birds of prey of northeastern Colorado. U.S. Dept. Interior. Biol. Program, Natural Resource Ecol. Lab. Grassland Biome Tech Rep. 211. Colorado State University, Fort Collins. 233 pp.

Olendorff, R.R and J.A. Stoddard. 1974. Potential management of raptors in western grasslands. Pp. 47-88 *in* (F.N. Hammerstrom Jr., B.E. Harrell, and R.R. Olendorff, eds.). Raptor Res. Report. No 2.

Olendorff, R.R. 1993. Status, biology and management of ferruginous hawks: a review. Raptor Res. And Tech. Asst. Cen., Spec. Rep. U.S. Dept. Interior, Bur. Land Manage., Boise, Id. 84 pp.

Prichard, D. C.Bridges, R.Krapf, S. Leonard, and W. Hagenbuck. 1994. Riparian Area Management - Process for assessing proper functioning condition for lentic riparian-wetland areas. U.S.D.I. Bureau of Land Management Lentic Riparian-Wetland Area Proper Functioning Condition Working Group. TR 1737-11. 37 pp.

Reynolds, R.T., R.T. Graham. M. Hildegard Reiser, R. L. Basset, P.L. Kennedy. D.A. Boyce, Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management recommendations for the northern goshawk in the southwestern United States. USDA Forest Service. Gen. Tech. Report RM-217. 90 pp.

Saab, V.A., C.E. Bock, T.D. Rich, and D.S. Dobkin. 1995. Livestock grazing effects in western North America. Pp. 311-353 *in* (T.E. Martin and D.M. Finch, eds.). Ecology and management of neotropical migratory birds: a synthesis and review of critical issues.

Schmutz, J.K. 1984. Ferruginous and Swainson's hawk abundance and distribution in relation to land use in southeastern Alberta. J. Wildl. Manage. 48:1180-1187

Sharp, B. 1986. Management guidelines for the Swainson's hawk. U.S. Fish and Wildlife Serv., Portland OR. 29 pp.

Snow, C. 1974. Habitat management series for unique or endangered species. U.S. Dep. Int., Bur. Land Manage. Tech. Note TN-255. 23pp

Stalmaster, M.V. 1987. The bald eagle. Universe Books, New York. 227 pp.

Stalmaster, M.V., W. Wright, J.M. Lockhart, and R. Krueger. 1982. Management of nesting ferruginous hawks in relation to coal development in Colorado and Utah. Pp. 205-209 *in* Issue and techniques in management of impacted western wildlife. Proc. of National Symposium, Steamboat Springs, CO. Thorne Ecological Institute, Tech. Pub. 14.

Swenson, J. E., K. L. Alt, and R. L. Eng. 1986. Ecology of bald eagles in the Greater Yellowstone Ecosystem. Wildlife Society, Wildlife Monograph No. 95, 46 pp.

Suter, G.W. II, and J.L. Joness. 1981. Criteria for golden eagle, ferruginous hawk and prairie falcon nest site protection. Raptor Research 15(1):12-18.

Synder, E.J,. and L.B. Best. 1988. Dynamics of habitat use by small mammals in prairie communities. Am. Mid. Nat. 119 (1): 128-136.

Thelander, C. G. 1973. Bald eagle reproduction in California, 1972-1973. Wildlife Branch Admin. Report No. 73-5, Cal. Dept. of Fish and Game, Sacramento, 17 pp.

Thompson, E.M.S. and W.L. Thompson. 1982. Beaver Dick, the honor and the heartbreak. An historical biography of Richard Leigh. Jelm Mountain Press, Laramie, WY., 162 pp.

Thompson, F.R.III, J.R. Probst, and M.G. Raphael. 1995. Impacts of silviculture: overview and management recommendations. Pp. 201-219 *in* (T.E. Martin and D.M. Finch, eds.). Ecology and management of neotropical migratory birds: a synthesis and review of critical issues.

U.S.D.I. 1986. Pour-on livestock insecticides kill bald eagles and other birds of prey. U.S. Fish and Wildlife Resource Information Bulletin No. 88-69. Corvallis, OR.

U.S.DI. 1987. Interagency Rocky Mountain Front wildlife monitoring /evaluation program. Bur. Land Manage., 71 pp

Van Horn, R.C. 1993. Ferruginous hawk and prairie falcon reproductive and behavioral responses to human activity near the Kevin Rim, Montana. Thesis. Montana State University, Bozeman. 86pp.

Whitfield, M. B., S. M. Patla, and P. F. Brussard. 1988. Idaho bald eagle research project, Greater Yellowstone Ecosystem Annual Report, Bureau of Land Managment, Idaho Falls, Idaho, 109 pp.

Whitfield, M. B., S. L. Austin, and G. Tomb. 1991. Continental Idaho Population Unit Interim Report. Idaho bald eagle research project, Greater Yellowstone Ecosystem, Bureau of Land Managment, Idaho Falls, Idaho, 104 pp.

Whitfield, M. B. 1993. South Fork Snake River, final report. Idaho Bald Eagle Research Project. U. S. D. I. Bur. of Land Manage., Idaho Falls, Idaho, 92 pp. plus appendices.

Whitfield, M.B., M.E. Maj. and P. Munholland. 1995 a. Inventory and monitoring of bald eagles and other raptorial birds of the Snake River, Idaho Bur. Land Manage. Tech. Bull. No.95-12. 75 pp.

Whitfield, M.B., M.E. Maj, J. Naderman, R. McFarling, J. Gardetto, K. Rice, B. Aber, N. Doyle, R. Welch, and B. Alford. 1995 b. Annual bald eagle productivity, final report. U.S. Bureau of Land Management, U.S. Forest Service, Targhee National Forest, Idaho Department of Fish and Game, and Norther Rockies Conservation Cooperative, Idaho Falls, 25 pp.

Woffinden, N.D., and J.R. Murphy. 1989. Decline of a ferruginous hawk population: a 20 year summary. J. Wildl. Manage. 53:1127-1132.

Woodbridge, B. 1985. Biology and management of Swainson's hawks in the Butte Valley, California. Klamath National Forest, Gooseneck Ranger District, Klamath Nat. For. 19 pp.

Young, L.S. 1989. Effects of agriculture on raptor in the western Unted States: an overview. Pp. 209-218 *in* (R.L. Glinski, B.G. Pendleton, M.B. Moss, M.N. LeFranc, Jr. B.A. Millsap, and S.W. Hoffman eds). Proc. Western Raptor Manage. Symp. Workshop. National Wildlife Federation, Washington, D.C.

Appendix Table 1. Sample sections selected for 1994-1995 presence/absence surveys for raptorial birds within the Snake River Study Area.

River Segment	Section	Comments
1	Sec. 7; T1S; R45E	Gravel pit and forest down river of dam; not covered by vegetation cover type photos.
1	Sec. 27;T1N; R44E	Irwin cemetary; not covered by vegetation cover type photos.
1	Sec. 20;T1N;R44E	Long Gulch area
1	Sec. 28;T1N;R44E	Little Box Canyon
1	Sec. 34;T1N;R44E	Palisades Rookery
1	Sec. 35;T1N;R44E	Irwin
1	Sec. 13;T1N;R43E	Squaw Creek area
2	Sec. 11;T1N; R43E	Fall Creek campground area; cover photos 127, 128
2	Sec. 30;T2N; R43E	Conant Valley; cover type photos 137, 138
2	Sec. 21;T2N; R43E	Pine Creek; not covered by vegetation cover photos.
3	Sec. 5; T2N; R43E	Dry Canyon south rim and fields to south
3	Sec. 8; T2N; R43E	Pine Creek Bench
3	Sec. 6; T2N; R43E	Upriver of Dry Canyon; cover type photos 147, 148
3	Sec. 32; T2N; R43E	North of Dry Canyon
3	Sec. 8; T3N; R42E	South side opposite Wolverine Canyon
3	Sec. 23; T3N; R42E	West of Lufkin bottom; cover type photo 159
3	Sec. 13; T3N; R42E	Black Canyon; cover type photos 159, 160
4	Sec. 9; T3N; R41E	Stinking Spring Canyon
4	Sec. 10; T3N; R41E	Wolf Flat and north

4	Sec. 15; T3N; R41E	Clark Hill; cover type photo 180
5	Sec. 25; T4N; R40E	Heise Bridge area
5	Sec. 26; T4N; R40E	Cress Creek area; cover type photos 194, 195, 196, 197
6	Sec. 35; T5N; R39E	Texas Slough;
7	Sec. 13; T5N; R38E	Annis rookery area; cov er type photos 157, 225, 224, 223.
7	Sec. 14; T5N; R38E	Butte at Confluence
7	Sec. 23; T5N; R38E	Annis Sloug[illegible] t Confluence
[illegible]	Sec. 17; T5N; R38E	Confluence PMP area; no cover type photos
7	Sec. 7; T5N; R38E	Upper Deer Parks
8	Sec. 14; T5N; R37E	Downriver of Deer Parks; no cover type photos
8	Sec. 35; T5N; R37E	Six canals; no cover type photos
8	Sec. 22; T5N; R37E	Mile 821, downriver of Deer Parks; no cover photos
9	Sec. 18; T5N; R38E	Keller's Island, downriver of Deer Parks
10	Sec. 2; T5N; R38E	West (downriver) of Cartier Slough
10	Sec. 31; T6N; R39E	East of Cartier Slough
11	Sec. 3; T6N; R39E	South of Hibbard Bridge
11	Sec. 33; T7N; R39E	Warm Slough near Hibbard Bridge; no cover photos.
11	Sec. 26; T7N; R39E	Henry's Fork above North Teton River confluence
11	Sec. 19; T7N; R40E	Downriver of old Ft. Henry; no cover type photos.
11	Sec. 17; T7N; R40E	North of Fort Henry

Appendix Table 2. Raptor presence survey results on Snake River Study area, 1994-1995							
(each record is of an individual raptor species detected within the quadrat.)							
Area or			Raptors	Habitat	Most prominant	Secondary or	
Quadrangle	STR	Quadrat	detected	Code	Habitat in Quadrat	Modification	
Palisades	7,1S,44E	1		421	421 Douglas fir	Clear-cut	
Palisades	7,1S,44E	2		421	421 Douglas fir		
Palisades	7,1S,44E	3		212	212 Pasture		
Palisades	7,1S,44E	4	Ha.le.	623	212 Pasture	623Cottonwood riparian	
Palisades	7,1S,44E	5		212	212 Pasture		
Palisades	7,1S,44E	6		131	131 Gravel pit		
Palisades	7,1S,44E	7		421	421 Douglas fir	Clear-cut	
Palisades	7,1S,44E	8		421	421 Douglas fir	Clear-cut	
Palisades	7,1S,44E	9	Bu.vi.	421	421 Douglas fir		
Palisades	7,1S,44E	10		412	412 Aspen		
Palisades	7,1S,44E	11	Ae.ac.	412	412 Aspen	421 Douglas-fir forest	
Palisades	7,1S,44E	12	Bu.vi.	421	321 Sagebrush	421 Douglas-fir forest	
Palisades	7,1S,44E	13	Bu.vi.	421	421 Douglas fir		
Palisades	7,1S,44E	14	Bu.vi.	421	412 Aspen	421 Douglas-fir forest	
Palisades	7,1S,44E	14	Ae.ac.	412	412 Aspen		
Palisades	7,1S,44E	15		421	421 Douglas fir		
Palisades	7,1S,44E	16		421	421 Douglas fir		
Swan Val cem	27,1N,44E	1		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	2		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	3		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	4		321	321 Sagebrush		
Swan Val cem	27,1N,44E	5		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	6		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	7		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	8		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	9		111	111 Residential		
Swan Val cem	27,1N,44E	10		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	11		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	12		211	211 Plowed cropland		
Swan Val cem	27,1N,44E	13		141	141 Roads		
Swan Val cem	27,1N,44E	14	Ha.le.	623	412 Aspen	623Cottonwood riparian	
Swan Val cem	27,1N,44E	15		421	421 Douglas fir		
Swan Val cem	27,1N,44E	16	Bu.vi.	421	421 Douglas fir		
Long Gulch	20,1N,44E	1		212	212 Pasture		
Long Gulch	20,1N,44E	2		111	111 Residential		
Long Gulch	20,1N,44E	3		111	111 Residential		
Long Gulch	20,1N,44E	4		111	111 Residential		
Long Gulch	20,1N,44E	5		111	111 Residential		
Long Gulch	20,1N,44E	6		211	211 Plowed cropland		
Long Gulch	20,1N,44E	7		211	211 Plowed cropland		
Long Gulch	20,1N,44E	8		511	511 River	623Cottonwood riparian	
Long Gulch	20,1N,44E	9		421	421 Douglas fir		
Long Gulch	20,1N,44E	10		623	623 Cottonwood	511 River, u. p.	
Long Gulch	20,1N,44E	11		212	212 Pasture	623Cottonwood riparian	
Long Gulch	20,1N,44E	12		212	212 Pasture		

Long Gulch	20,1N,44E	13		623	623 Cottonwood	511 River, u. p.	
Long Gulch	20,1N,44E	14		421	421 Douglas fir	511 River, u. p.	
Long Gulch	20,1N,44E	15		421	421 Douglas fir		
Long Gulch	20,1N,44E	16	Ae.ac.	421	421 Douglas fir		
Falls C.G.	11,1N,43E	1		623	623 Cottonwood		
Falls C.G.	11,1N,43E	2	Bu.vi.	623	623 Cottonwood		
Falls C.G.	11,1N,43E	2	Pa.ha.	623	623 Cottonwood		
Falls C.G.	11,1N,43E	2	Ha.le.	623	623 Cottonwood		
Falls C.G.	11,1N,43E	3	Ha.le.	623	623 Cottonwood	511 River, u. p.	
Falls C.G.	11,1N,43E	3	Fa.sp.	623	623 Cottonwood	511 River, u. p.	
Falls C.G.	11,1N,43E	4	Ha.le.	623	623 Cottonwood	511 River, u. p.	nest
Falls C.G.	11,1N,43E	5	Ha.le.	623	623 Cottonwood	421 Douglas-fir	
Falls C.G.	11,1N,43E	6	Ha.le.	623	623 Cottonwood	421 Douglas-fir	
Falls C.G.	11,1N,43E	6	Ac.co.	421	623 Cottonwood	421 Douglas-fir	
Falls C.G.	11,1N,43E	7	Bu.ja.	623	623 Cottonwood	421 Douglas-fir	
Falls C.G.	11,1N,43E	8	Ae.ac.	421	421 Douglas fir	623Cottonwood	
Falls C.G.	11,1N,43E	8	Bu.ja.	421	421 Douglas fir		
Falls C.G.	11,1N,43E	8	Ac.co.	421	421 Douglas fir		nests
Falls C.G.	11,1N,43E	9		421	421 Douglas fir	412 Aspen o.	
Falls C.G.	11,1N,43E	10	Bu.ja.	421	421 Douglas fir	412 Aspen o.	
Falls C.G.	11,1N,43E	11		421	421 Douglas fir	321 Sagebrush	
Falls C.G.	11,1N,43E	12	Pa.ha.	421	421 Douglas fir	141 Roads	
Falls C.G.	11,1N,43E	13		211	211 Plowed cropland		
Falls C.G.	11,1N,43E	14		211	211 Plowed cropland		
Falls C.G.	11,1N,43E	15		211	211 Plowed cropland		
Falls C.G.	11,1N,43E	16		211	211 Plowed cropland		
Conant Valley	30,2N,43E	1		212	212 Pasture		
Conant Valley	30,2N,43E	2		141	141 Roads	212 Pasture	
Conant Valley	30,2N,43E	3	Ha.le.	623	623 Cottonwood	212 Pasture	
Conant Valley	30,2N,43E	4	Ha.le.	212	212 Pasture	511 River, u. p.	
Conant Valley	30,2N,43E	5	Ha.le.	623	212 Pasture	623Cottonwood	riparian
Conant Valley	30,2N,43E	6	Ha.le.	623	212 Pasture	623Cottonwood	riparian
Conant Valley	30,2N,43E	7		141	141 Roads	212 Pasture	
Conant Valley	30,2N,43E	8		212	212 Pasture		
Conant Valley	30,2N,43E	9		241	241 Ag buildings	421 Douglas fir	
Conant Valley	30,2N,43E	10		141	141 Roads	212 Pasture	
Conant Valley	30,2N,43E	11	Ha.le.	623	623 Cottonwood	212 Pasture	
Conant Valley	30,2N,43E	12	Ha.le.	212	212 Pasture	511 River, u. p.	
Conant Valley	30,2N,43E	13	Ha.le.	623	623 Cottonwood		nest
Conant Valley	30,2N,43E	13	Bu.ja.	623	623 Cottonwood		nest
Conant Valley	30,2N,43E	14	Bu.ja.	623	623 Cottonwood	141 Roadway	
Conant Valley	30,2N,43E	15		241	241 Ag buildings		
Conant Valley	30,2N,43E	16		211	211 Plowed cropland		
Pine Creek	21,2N,43E	1	Aq.ch.	321	321 Sagebrush	741 Cliff	
Pine Creek	21,2N,43E	1	Fa.me.	321	321 Sagebrush	741 Cliff	
Pine Creek	21,2N,43E	2	Aq.ch.	321	321 Sagebrush	741 Cliff	
Pine Creek	21,2N,43E	3		741	741 Cliffs	321 Sagebrush	
Pine Creek	21,2N,43E	4	Bu.ja.	421	421 Douglas fir	741 Cliff	
Pine Creek	21,2N,43E	4	Fa.sp.	421	421 Douglas fir	741 Cliff	
Pine Creek	21,2N,43E	5		211	211 Plowed cropland		

Pine Creek	21,2N,43E	6		421	421 Douglas fir	211 Plowed c.	
Pine Creek	21,2N,43E	7	Bu.ja.	421	421 Douglas fir	211 Plowed c.	
Pine Creek	21,2N,43E	8	Ha.le.	421	421 Douglas fir	211 Plowed c.	
Pine Creek	21,2N,43E	9		211	211 Plowed cropland		
Pine Creek	21,2N,43E	10		211	211 Plowed cropland		
Pine Creek	21,2N,43E	11		211	211 Plowed cropland		
Pine Creek	21,2N,43E	12		211	211 Plowed cropland		
Pine Creek	21,2N,43E	13		211	211 Plowed cropland		
Pine Creek	21,2N,43E	14		211	211 Plowed cropland		
Pine Creek	21,2N,43E	15		211	211 Plowed cropland		
Pine Creek	21,2N,43E	16		211	211 Plowed cropland		
Wh. Mtn/Dry Can	4,2N,43E	1	Ot.fl.	421	421 Douglas fir	412 Aspen o.	
Wh. Mtn/Dry Can	4,2N,43E	2	Ot.fl.	421	421 Douglas fir	412 Aspen o.	
Wh. Mtn/Dry Can	4,2N,43E	2	Bu.vi.	421	421 Douglas fir	412 Aspen o.	
Wh. Mtn/Dry Can	4,2N,43E	3		412	412 Aspen		
Wh. Mtn/Dry Can	4,2N,43E	4	Ac.st.	421	421 Douglas fir		
Wh. Mtn/Dry Can	4,2N,43E	5	Bu.ja.	412	412 Aspen		
Wh. Mtn/Dry Can	4,2N,43E	5	Bu.vi.	412	412 Aspen		
Wh. Mtn/Dry Can	4,2N,43E	6	Ci.cy.	321	321 Sagebrush		
Wh. Mtn/Dry Can	4,2N,43E	6	Ca.au.	321	321 Sagebrush		
Wh. Mtn/Dry Can	4,2N,43E	7		211	211 Plowed cropland		
Wh. Mtn/Dry Can	4,2N,43E	8		211	211 Plowed cropland		
Wh. Mtn/Dry Can	4,2N,43E	9		211	211 Plowed cropland		
Wh. Mtn/Dry Can	4,2N,43E	10		211	211 Plowed cropland		
Wh. Mtn/Dry Can	4,2N,43E	11		211	211 Plowed cropland	412 Aspen o.	
Wh. Mtn/Dry Can	4,2N,43E	12		412	412 Aspen		
Wh. Mtn/Dry Can	4,2N,43E	13		211	211 Plowed cropland	412 Aspen o.	
Wh. Mtn/Dry Can	4,2N,43E	14		211	211 Plowed cropland		
Wh. Mtn/Dry Can	4,2N,43E	15		211	211 Plowed cropland		
Wh. Mtn/Dry Can	4,2N,43E	16		211	211 Plowed cropland		
Wh. Mtn/Dry Can	5,2N,43E	1	Ha.le.	421	421 Douglas fir		
Wh. Mtn/Dry Can	5,2N,43E	2	Bu.ja.	421	421 Douglas fir		
Wh. Mtn/Dry Can	5,2N,43E	3	Ot.fl.	421	421 Douglas fir		
Wh. Mtn/Dry Can	5,2N,43E	4	Ot.fl.	421	421 Douglas fir		
Wh. Mtn/Dry Can	5,2N,43E	4	Bu.ja.	421	421 Douglas fir		
Wh. Mtn/Dry Can	5,2N,43E	4	As.ot.	421	421 Douglas fir		
Wh. Mtn/Dry Can	5,2N,43E	5		211	211 Plowed cropland		
Wh. Mtn/Dry Can	5,2N,43E	6		311	311 Upland grassland		
Wh. Mtn/Dry Can	5,2N,43E	7		311	311 Upland grassland		
Wh. Mtn/Dry Can	5,2N,43E	8	Aq.ch.	311	311 Upland grassland	321 Sagebrush	
Wh. Mtn/Dry Can	5,2N,43E	9		321	321 Sagebrush		
Wh. Mtn/Dry Can	5,2N,43E	10		211	211 Plowed cropland		
Wh. Mtn/Dry Can	5,2N,43E	11		211	211 Plowed cropland		
Wh. Mtn/Dry Can	5,2N,43E	12		211	211 Plowed cropland		
Wh. Mtn/Dry Can	5,2N,43E	13		211	211 Plowed cropland		
Wh. Mtn/Dry Can	5,2N,43E	14		211	211 Plowed cropland		
Wh. Mtn/Dry Can	5,2N,43E	15		211	211 Plowed cropland		
Wh. Mtn/Dry Can	5,2N,43E	16		311	311 Upland grassland		
Wh. Mtn/Dry Can	6,2N,43E	1		211	211 Plowed cropland		
Wh. Mtn/Dry Can	6,2N,43E	2	Ca.au.	741	321 Sagebrush		
Wh. Mtn/Dry Can	6,2N,43E	3	Bu.ja.	321	321 Sagebrush	511 Upper Peren.	
Wh. Mtn/Dry Can	6,2N,43E	3	Ha.le.	421	321 Sagebrush	511 Upper Peren.	

Wh. Mtn/Dry Can	6,2N,43E	4	Ha.le.	623	623 Cottonwood	321 Sagebrush	
Wh. Mtn/Dry Can	6,2N,43E	5		421	421 Douglas fir	321 Sagebrush	
Wh. Mtn/Dry Can	6,2N,43E	6	Ha.le.	623	511 River	623 Cottonwood	
Wh. Mtn/Dry Can	6,2N,43E	7	Bu.ja.	321	321 Sagebrush		
Wh. Mtn/Dry Can	6,2N,43E	7	Fa.sp.	412	321 Sagebrush	412 Aspen	
Wh. Mtn/Dry Can	6,2N,43E	7	Ha.le.	623	321 Sagebrush		
Wh. Mtn/Dry Can	6,2N,43E	7	Aq.ch.	321	321 Sagebrush		
Wh. Mtn/Dry Can	6,2N,43E	8	Fa.sp.	211	211 Plowed cropland	412 Aspen	
Wh. Mtn/Dry Can	6,2N,43E	9	Bu.ja.	211	211 Plowed cropland	412 Aspen	
Wh. Mtn/Dry Can	6,2N,43E	10	Ae.ac.	421	211 Plowed cropland	412 Aspen	
Wh. Mtn/Dry Can	6,2N,43E	11	Ha.le.	421	421 Douglas fir		
Wh. Mtn/Dry Can	6,2N,43E	12	Ha.le.	421	421 Douglas fir		
Wh. Mtn/Dry Can	6,2N,43E	13	Ha.le.	623	321 Sagebrush		
Wh. Mtn/Dry Can	6,2N,43E	13	Aq.ch.	741	321 Sagebrush		
Wh. Mtn/Dry Can	6,2N,43E	14	Ae.ac.	421	421 Douglas fir		
Wh. Mtn/Dry Can	6,2N,43E	15		211	211 Plowed cropland	412 Aspen	
Wh. Mtn/Dry Can	6,2N,43E	16		211	211 Plowed cropland	412 Aspen	
North Dry	32,3N,43E	1	Ha.le.	623	623 Cottonwood	741 Cliff	
North Dry	32,3N,43E	2		412	412 Aspen		
North Dry	32,3N,43E	3		412	412 Aspen		
North Dry	32,3N,43E	4		421	421 Douglas fir	321 Sagebrush	
North Dry	32,3N,43E	5		412	412 Aspen		
North Dry	32,3N,43E	6		412	412 Aspen		
North Dry	32,3N,43E	7	Bu.ja.	412	412 Aspen	741 Cliff	
North Dry	32,3N,43E	8	Ha.le.	623	623 Cottonwood		
North Dry	32,3N,43E	9	Ha.le.	623	623 Cottonwood		
North Dry	32,3N,43E	10	Bu.ja.	412	412 Aspen	741 Cliff	
North Dry	32,3N,43E	10	Ha.le.	421	412 Aspen	741 Cliff	
North Dry	32,3N,43E	10	Fa.sp.	412	412 Aspen	741 Cliff	
North Dry	32,3N,43E	11		412	412 Aspen		
North Dry	32,3N,43E	12		412	412 Aspen		
North Dry	32,3N,43E	13		321	321 Sagebrush		
North Dry	32,3N,43E	14		321	321 Sagebrush	412 Aspen	
North Dry	32,3N,43E	15		321	321 Sagebrush	412 Apsen	
North Dry	32,3N,43E	16	Ha.le.	623	623 Cottonwood	511 Upper Peren.	
Wh. Mtn/Lufkin	23,3N,42E	1		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	2		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	3		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	4	Fa.sp.	623	623 Cottonwood		
Wh. Mtn/Lufkin	23,3N,42E	4	Fa.pe.	421	623 Cottonwood		
Wh. Mtn/Lufkin	23,3N,42E	4	Bu.ja.	623	623 Cottonwood		
Wh. Mtn/Lufkin	23,3N,42E	5	Bu.sw.	211	211 Plowed cropland	412 Aspen	
Wh. Mtn/Lufkin	23,3N,42E	6	Bu.sw.	211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	7		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	8		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	9		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	10		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	11		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	12		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	13		211	211 Plowed cropland		

Wh. Mtn/Lufkin	23,3N,42E	14		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	15		211	211 Plowed cropland		
Wh. Mtn/Lufkin	23,3N,42E	16		211	211 Plowed cropland		
Wh. Mtn/Black Ca	13,3N,42E	1		623	623 Cottonwood	511 River	
Wh. Mtn/Black Ca	13,3N,42E	2		421	421 Douglas fir	623 Cottonwood	
Wh. Mtn/Black Ca	13,3N,42E	3		322	322 Mtn. Mahogany		
Wh. Mtn/Black Ca	13,3N,42E	4		421	421 Douglas fir		
Wh. Mtn/Black Ca	13,3N,42E	5		322	322 Mtn. Mahogany	421 Douglas fir	
Wh. Mtn/Black Ca	13,3N,42E	6		321	321 Sagebrush		
Wh. Mtn/Black Ca	13,3N,42E	7	Fa.sp.	422	421 Douglas fir		
Wh. Mtn/Black Ca	13,3N,42E	7	Ha.le.	623	421 Douglas fir	623 Cottonwood	
Wh. Mtn/Black Ca	13,3N,42E	8		621	621 Willow	623 Cottonwood	
Wh. Mtn/Black Ca	13,3N,42E	9	Ha.le.	623	623 Cottonwood	511 River	
Wh. Mtn/Black Ca	13,3N,42E	10	Bu.ja.	623	421 Douglas fir		
Wh. Mtn/Black Ca	13,3N,42E	11	Fa.sp.	412	421 Douglas fir		
Wh. Mtn/Black Ca	13,3N,42E	11	As.ot.	421	421 Douglas fir		
Wh. Mtn/Black Ca	13,3N,42E	11	Ac.ge.	421	421 Douglas fir		
Wh. Mtn/Black Ca	13,3N,42E	12	Bu.ja.	421	421 Douglas fir		
Wh. Mtn/Black Ca	13,3N,42E	12	Fa.sp.	421	421 Douglas fir		
Wh. Mtn/Black Ca	13,3N,42E	13	Fa.sp.	322	322 Mtn. Mahogany		
Wh. Mtn/Black Ca	13,3N,42E	13	Fa.pe.	741	322 Mtn. Mahogany	741 Cliffs	
Wh. Mtn/Black Ca	13,3N,42E	14	Ha.le.	623	321 Sagebrush		
Wh. Mtn/Black Ca	13,3N,42E	14	Bu.ja.	321	321 Sagebrush		
Wh. Mtn/Black Ca	13,3N,42E	14	Fa.sp.	321	321 Sagebrush		
Wh. Mtn/Black Ca	13,3N,42E	15	Bu.ja.	321	321 Sagebrush		
Wh. Mtn/Black Ca	13,3N,42E	15	Ha.le.	623	321 Sagebrush	623 Cottonwood	
Wh. Mtn/Black Ca	13,3N,42E	16		623	623 Cottonwood		
Heise SE	10,3N,41E	1		321	321 Sagebrush		
Heise SE	10,3N,41E	2		321	321 Sagebrush		
Heise SE	10,3N,41E	3		321	321 Sagebrush		
Heise SE	10,3N,41E	4		321	321 Sagebrush		
Heise SE	10,3N,41E	5		321	321 Sagebrush		
Heise SE	10,3N,41E	6		321	321 Sagebrush		
Heise SE	10,3N,41E	7		321	321 Sagebrush		
Heise SE	10,3N,41E	8		321	321 Sagebrush		
Heise SE	10,3N,41E	9		321	321 Sagebrush		
Heise SE	10,3N,41E	10		321	321 Sagebrush		
Heise SE	10,3N,41E	11	Ha.le.	321	321 Sagebrush		
Heise SE	10,3N,41E	12		321	321 Sagebrush		
Heise SE	10,3N,41E	13	Ha.le.	623	321 Sagebrush		
Heise SE	10,3N,41E	14	Fa.sp.	623	321 Sagebrush		
Heise SE	10,3N,41E	15	Bu.ja.	321	321 Sagebrush	741 Cliffs	
Heise SE	10,3N,41E	16		321	321 Sagebrush		
Clark Hill	15,3N,41E	1	Ca.au.	321	321 Sagebrush	741 Cliffs	
Clark Hill	15,3N,41E	1	Bu.ja.	321	321 Sagebrush	741 Cliffs	
Clark Hill	15,3N,41E	1	Fa.sp.	321	321 Sagebrush	741 Cliffs	
Clark Hill	15,3N,41E	2	Fa.sp.	321	321 Sagebrush	741 Cliffs	
Clark Hill	15,3N,41E	2	Bu.ja.	321	321 Sagebrush	741 Cliffs	
Clark Hill	15,3N,41E	2	Bu.ja.	623	321 Sagebrush	741 Cliffs	
Clark Hill	15,3N,41E	2	Ha.le.	623	321 Sagebrush	741 Cliffs	

Clark Hill	15,3N,41E	2	Aq.ch.	321	321 Sagebrush	741 Cliffs	
Clark Hill	15,3N,41E	3	Bu.ja.	623	623 Cottonwood	511 River	
Clark Hill	15,3N,41E	4	Bu.ja.	623	421 Douglas fir	741 Cliffs	
Clark Hill	15,3N,41E	4	Bu.sw.	421	421 Douglas fir	741 Cliffs	
Clark Hill	15,3N,41E	4	Ha.le.	421	421 Douglas fir	741 Cliffs	
Clark Hill	15,3N,41E	5	Ca.au.	211	211 Plowed cropland		
Clark Hill	15,3N,41E	6		211	211 Plowed cropland	321 Sagebrush	
Clark Hill	15,3N,41E	7		623	623 Cottonwood	511 River	
Clark Hill	15,3N,41E	8		511	511 River	623 Cottonwood	
Clark Hill	15,3N,41E	9	Ha.le.	741	741 Cliffs	421 Douglas fir	
Clark Hill	15,3N,41E	10	Aq.ch.	321	741 Cliffs	421 Douglas fir	
Clark Hill	15,3N,41E	11		421	421 Douglas fir	741 Cliffs	
Clark Hill	15,3N,41E	12		211	211 Plowed cropland	Ranch buildings	
Clark Hill	15,3N,41E	13	Ha.le.	211	211 Plowed cropland	Aspen	
Clark Hill	15,3N,41E	14		211	211 Plowed cropland	Aspen	
Clark Hill	15,3N,41E	15		211	211 Plowed cropland		
Clark Hill	15,3N,41E	16		211	211 Plowed cropland		
Cress	26,4N,40E	1	Fa.sp.	623	623 Cottonwood	211 Plowed cropland	
Cress	26,4N,40E	1	Bu.ja.	623	623 Cottonwood	211 Plowed cropland	
Cress	26,4N,40E	2	Ha.le.	623	623 Cottonwood	211 Plowed cropland	
Cress	26,4N,40E	3	Ha.le.	623	623 Cottonwood	511 River	
Cress	26,4N,40E	4		422	422 Juniper	321 Sagebrush	
Cress	26,4N,40E	5		623	623 Cottonwood	511 River	
Cress	26,4N,40E	6	Fa.sp.	623	623 Cottonwood	511 River	
Cress	26,4N,40E	7		211	211 Plowed cropland	623 Cottonwood	
Cress	26,4N,40E	8		211	211 Plowed cropland		
Cress	26,4N,40E	9		211	211 Plowed cropland		
Cress	26,4N,40E	10		211	211 Plowed cropland		
Cress	26,4N,40E	11		211	211 Plowed cropland	623 Cottonwood	
Cress	26,4N,40E	12		623	623 Cottonwood	211 Plowed cropland	
Cress	26,4N,40E	13		211	211 Plowed cropland		
Cress	26,4N,40E	14		211	211 Plowed cropland		
Cress	26,4N,40E	15		211	211 Plowed cropland		
Cress	26,4N,40E	16		211	211 Plowed cropland	141 Roads	
Texas Slough	5,T5N,R39	1		211	211 Plowed cropland		
Texas Slough	5,T5N,R39	2		211	211 Plowed cropland		
Texas Slough	5,T5N,R39	3		211	211 Plowed cropland		
Texas Slough	5,T5N,R39	4		211	211 Plowed cropland		
Texas Slough	5,T5N,R39	5		211	211 Plowed cropland	623 Cottonwood	
Texas Slough	5,T5N,R39	6		211	211 Plowed cropland		
Texas Slough	5,T5N,R39	7		211	211 Plowed cropland		
Texas Slough	5,T5N,R39	8		211	211 Plowed cropland		
Texas Slough	5,T5N,R39	9		623	623 Cottonwood	211 Plowed cropland	
Texas Slough	5,T5N,R39	10		511	511 River	623 Cottonwood	
Texas Slough	5,T5N,R39	11		623	623 Cottonwood	511 River	
Texas Slough	5,T5N,R39	12		211	211 Plowed cropland	623 Cottonwood	
Texas Slough	5,T5N,R39	13		623	623 Cottonwood	511 River	
Texas Slough	5,T5N,R39	14	Ca.au.	623	623 Cottonwood	511 River	
Texas Slough	5,T5N,R39	14	Bu.ja.	623	623 Cottonwood	511 River	
Texas Slough	5,T5N,R39	14	Ha.le.	623	623 Cottonwood	511 River	

Texas Slough	5,T5N,R39	15	Pa.ha.	623	623 Cottonwood	511 River	
Texas Slough	5,T5N,R39	15	Ha.le.	623	623 Cottonwood	511 River	
Texas Slough	5,T5N,R39	16		511	511 River	623 Cottonwood	
Annis Rookery	3,T5N,R38	1		623	623 Cottonwood		
Annis Rookery	3,T5N,R38	2		623	623 Cottonwood		
Annis Rookery	3,T5N,R38	3		211	211 Plowed cropland	623 Cottonwood	
Annis Rookery	3,T5N,R38	4		211	211 Plowed cropland	623 Cottonwood	
Annis Rookery	3,T5N,R38	5	Ha.le.	623	623 Cottonwood	511 River	
Annis Rookery	3,T5N,R38	6		511	511 River	623 Cottonwood	
Annis Rookery	3,T5N,R38	7		623	623 Cottonwood	511 River	
Annis Rookery	3,T5N,R38	8		623	623 Cottonwood	511 River	
Annis Rookery	3,T5N,R38	9		623	623 Cottonwood	511 River	
Annis Rookery	3,T5N,R38	10		511	511 River	623 Cottonwood	
Annis Rookery	3,T5N,R38	11	Bu.vi.	623	623 Cottonwood	211 Plowed cropland	
Annis Rookery	3,T5N,R38	12	Ha.le.	623	511 River	623 Cottonwood	
Annis Rookery	3,T5N,R38	13	Ha.le.	623	211 Plowed cropland	623 Cottonwood	
Annis Rookery	3,T5N,R38	13	Bu.ja.	623	211 Plowed cropland	623 Cottonwood	
Annis Rookery	3,T5N,R38	14		211	211 Plowed cropland	623 Cottonwood	
Annis Rookery	3,T5N,R38	15		623	623 Cottonwood	511 River	
Annis Rookery	3,T5N,R38	16		511	511 River	623 Cottonwood	
Confluence	7,T5N,R38	1		511	511 River	623 Cottonwood	
Confluence	7,T5N,R38	2	Ha.le.	623	623 Cottonwood	511 River	
Confluence	7,T5N,R38	3	Ha.le.	623	623 Cottonwood	212 Pasture	nest
Confluence	7,T5N,R38	4		212	212 Pasture	623 Cottonwood	
Confluence	7,T5N,R38	5		212	212 Pasture	623 Cottonwood	
Confluence	7,T5N,R38	6	Ha.le.	623	623 Cottonwood	212 Pasture	
Confluence	7,T5N,R38	7	Ha.le.	511	511 River	623 Cottonwood	
Confluence	7,T5N,R38	8		623	623 Cottonwood	212 Pasture	
Confluence	7,T5N,R38	9	Ha.le.	321	623 Cottonwood	511 River	
Confluence	7,T5N,R38	9	Bu.ja.	321	623 Cottonwood	511 River	
Confluence	7,T5N,R38	10	Ha.le.	511	511 River	623 Cottonwood	
Confluence	7,T5N,R38	11	Ha.le.	623	623 Cottonwood	511 River	nest
Confluence	7,T5N,R38	12	Ha.le.	623	623 Cottonwood	511 River	
Confluence	7,T5N,R38	13	Ha.le.	623	623 Cottonwood	511 River	
Confluence	7,T5N,R38	14	Ha.le.	511	511 River	623 Cottonwood	
Confluence	7,T5N,R38	15	Ha.le.	623	623 Cottonwood	511 River	
Confluence	7,T5N,R38	15	Bu.sw.	623	623 Cottonwood	511 River	
Confluence	7,T5N,R38	16	Ha.le.	623	623 Cottonwood	511 River	
Upper Deer Parks	7,5N,38E	1		321	321 Sagebrush		
Upper Deer Parks	7,5N,38E	2	Bu.ja.	623	321 Sagebrush		
Upper Deer Parks	7,5N,38E	3		321	321 Sagebrush		
Upper Deer Parks	7,5N,38E	4		321	321 Sagebrush		
Upper Deer Parks	7,5N,38E	5		321	321 Sagebrush		
Upper Deer Parks	7,5N,38E	6		321	321 Sagebrush		
Upper Deer Parks	7,5N,38E	7		321	321 Sagebrush		
Upper Deer Parks	7,5N,38E	8		623	623 Cottonwood		
Upper Deer Parks	7,5N,38E	9		623	623 Cottonwood		
Upper Deer Parks	7,5N,38E	10		623	623 Cottonwood		
Upper Deer Parks	7,5N,38E	11		623	623 Cottonwood		
Upper Deer Parks	7,5N,38E	12		321	321 Sagebrush		

Upper Deer Parks	7,5N,38E	13	Bu.vi.	623	623 Cottonwood		
Upper Deer Parks	7,5N,38E	14		623	623 Cottonwood		
Upper Deer Parks	7,5N,38E	15		211	211 Plowed cropland		
Upper Deer Parks	7,5N,38E	16		211	211 Plowed cropland		
Deer Parks	12,5N,37E	1		321	321 Sagebrush		
Deer Parks	12,5N,37E	2		321	321 Sagebrush		
Deer Parks	12,5N,37E	3		321	321 Sagebrush		
Deer Parks	12,5N,37E	4	Bu.ja.	623	321 Sagebrush		
Deer Parks	12,5N,37E	5	Bu.ja.	623	623 Cottonwood	511 River	
Deer Parks	12,5N,37E	6	Fa.sp.	321	623 Cottonwood	321 Sagebrush	
Deer Parks	12,5N,37E	7		321	321 Sagebrush		
Deer Parks	12,5N,37E	8		321	321 Sagebrush		
Deer Parks	12,5N,37E	9		321	321 Sagebrush		
Deer Parks	12,5N,37E	10		623	623 Cottonwood		
Deer Parks	12,5N,37E	11		623	623 Cottonwood		
Deer Parks	12,5N,37E	12	Ha.le.	623	623 Cottonwood		
Deer Parks	12,5N,37E	13		211	211 Plowed cropland		
Deer Parks	12,5N,37E	14	Ha.le.	623	623 Cottonwood		
Deer Parks	12,5N,37E	15	Bu.sw.	623	623 Cottonwood		
Deer Parks	12,5N,37E	16		623	623 Cottonwood	321 Sagebrush	
Deer Parks	14,5N,37E	1	Ci.cy.	321	321 Sagebrush		
Deer Parks	14,5N,37E	2	Ci.cy.	321	321 Sagebrush		
Deer Parks	14,5N,37E	3		321	321 Sagebrush		
Deer Parks	14,5N,37E	4	Bu.vi.	623	623 Cottonwood		
Deer Parks	14,5N,37E	5	Fa.sp.	623	511 River		
Deer Parks	14,5N,37E	6		511	511 River	211 Plowed cropland	
Deer Parks	14,5N,37E	7	Fa.sp.	623	623 Cottonwood	621 Willow	
Deer Parks	14,5N,37E	7	Bu.ja.	623	623 Cottonwood	621 Willow	
Deer Parks	14,5N,37E	8	Bu.sw.	623	623 Cottonwood	621 Willow	
Deer Parks	14,5N,37E	8	Fa.sp.	623	623 Cottonwood	621 Willow	
Deer Parks	14,5N,37E	9	Bu.vi.	623	623 Cottonwood	621 Willow	
Deer Parks	14,5N,37E	10		623	623 Cottonwood	51 Upper per.	
Deer Parks	14,5N,37E	11		211	211 Plowed cropland		
Deer Parks	14,5N,37E	12		211	211 Plowed cropland		
Deer Parks	14,5N,37E	13		211	211 Plowed cropland		
Deer Parks	14,5N,37E	14		211	211 Plowed cropland		
Deer Parks	14,5N,37E	15		321	321 Sagebrush	211 Plowed c.	
Deer Parks	14,5N,37E	16		623	623 Cottonwood	621 Willow	
Lewisville	22,5N,37E	1		321	321 Sagebrush		
Lewisville	22,5N,37E	2		321	321 Sagebrush		
Lewisville	22,5N,37E	3		321	321 Sagebrush		
Lewisville	22,5N,37E	4	Bu.ja.	623	623 Cottonwood	621 Willow	
Lewisville	22,5N,37E	4	Bu.sw.	623	623 Cottonwood	621 Willow	
Lewisville	22,5N,37E	5		623	623 Cottonwood	621 Willow	
Lewisville	22,5N,37E	6	Fa.sp.	623	623 Cottonwood	621 Willow	
Lewisville	22,5N,37E	7		321	321 Sagebrush		
Lewisville	22,5N,37E	8		321	321 Sagebrush		
Lewisville	22,5N,37E	9		321	321 Sagebrush	623 Cottonwood	
Lewisville	22,5N,37E	10	Ci.cy.	621	623 Cottonwood	621 Willow	
Lewisville	22,5N,37E	10	Ha.le.	623	623 Cottonwood	621 Willow	

Lewisville	22,5N,37E	10	Fa.sp.	623	623 Cottonwood	621 Willow	
Lewisville	22,5N,37E	11	Ha.le.	623	623 Cottonwood	621 Willow	
Lewisville	22,5N,37E	12		623	623 Cottonwood		
Lewisville	22,5N,37E	13		511	511 River	212 Perm. Past	
Lewisville	22,5N,37E	14	Ha.le.	211	211 Plowed cropland	623 Cottonwood	
Lewisville	22,5N,37E	14	Bu.ja.	211	211 Plowed cropland	623 Cottonwood	
Lewisville	22,5N,37E	15		623	623 Cottonwood		
Lewisville	22,5N,37E	16		211	211 Plowed cropland	623 Cottonwood	
Lewisville	35,5N,37E	1		511	511 River		
Lewisville	35,5N,37E	2		211	211 Plowed cropland		
Lewisville	35,5N,37E	3		211	211 Plowed cropland		
Lewisville	35,5N,37E	4		211	211 Plowed cropland		
Lewisville	35,5N,37E	5		211	211 Plowed cropland		
Lewisville	35,5N,37E	6		211	211 Plowed cropland		
Lewisville	35,5N,37E	7		211	211 Plowed cropland		
Lewisville	35,5N,37E	8		211	211 Plowed cropland		
Lewisville	35,5N,37E	9		211	211 Plowed cropland	131 Quarry	
Lewisville	35,5N,37E	10		211	211 Plowed cropland		
Lewisville	35,5N,37E	11		211	211 Plowed cropland		
Lewisville	35,5N,37E	12		211	211 Plowed cropland		
Lewisville	35,5N,37E	13		211	211 Plowed cropland		
Lewisville	35,5N,37E	14		211	211 Plowed cropland		
Lewisville	35,5N,37E	15		211	211 Plowed cropland		
Lewisville	35,5N,37E	16		211	211 Plowed cropland	131 Quarry	
Deer Parks	18,5N,38E	1		211	211 Plowed cropland		
Deer Parks	18,5N,38E	2		211	211 Plowed cropland		
Deer Parks	18,5N,38E	3		623	623 Cottonwood		
Deer Parks	18,5N,38E	4		623	623 Cottonwood		
Deer Parks	18,5N,38E	5		623	623 Cottonwood		
Deer Parks	18,5N,38E	6	Ha.le.	623	623 Cottonwood		
Deer Parks	18,5N,38E	7	Bu.sw.	623	623 Cottonwood		
Deer Parks	18,5N,38E	8		211	211 Plowed cropland		
Deer Parks	18,5N,38E	9		211	211 Plowed cropland		
Deer Parks	18,5N,38E	10		211	211 Plowed cropland		
Deer Parks	18,5N,38E	11		211	211 Plowed cropland		
Deer Parks	18,5N,38E	12		211	211 Plowed cropland		
Deer Parks	18,5N,38E	13		211	211 Plowed cropland		
Deer Parks	18,5N,38E	14		211	211 Plowed cropland		
Deer Parks	18,5N,38E	15		211	211 Plowed cropland		
Deer Parks	18,5N,38E	16		211	211 Plowed cropland		
Habitats in Samples: 437 records, 111=5, 131=1, 141=4, 211=129, 212=14, 241=2, 311=4, 321=75, 322=4,							
412=19, 421=55, 422=1, 511=17, 621=1, 623=103, 741=3.							
179 records of birds seen, 258 with no birds							
89 had one species, 22 had two species, 12 had 3 species, 1 had 4, 1 had 5 species.							
The quadrats with 4 and 5 species were sagebrush.							

Bureau of Land Management
Idaho State Office
3380 Americana Terrace
Boise, Idaho 83706

BLM/ID/PT-96/023+1150